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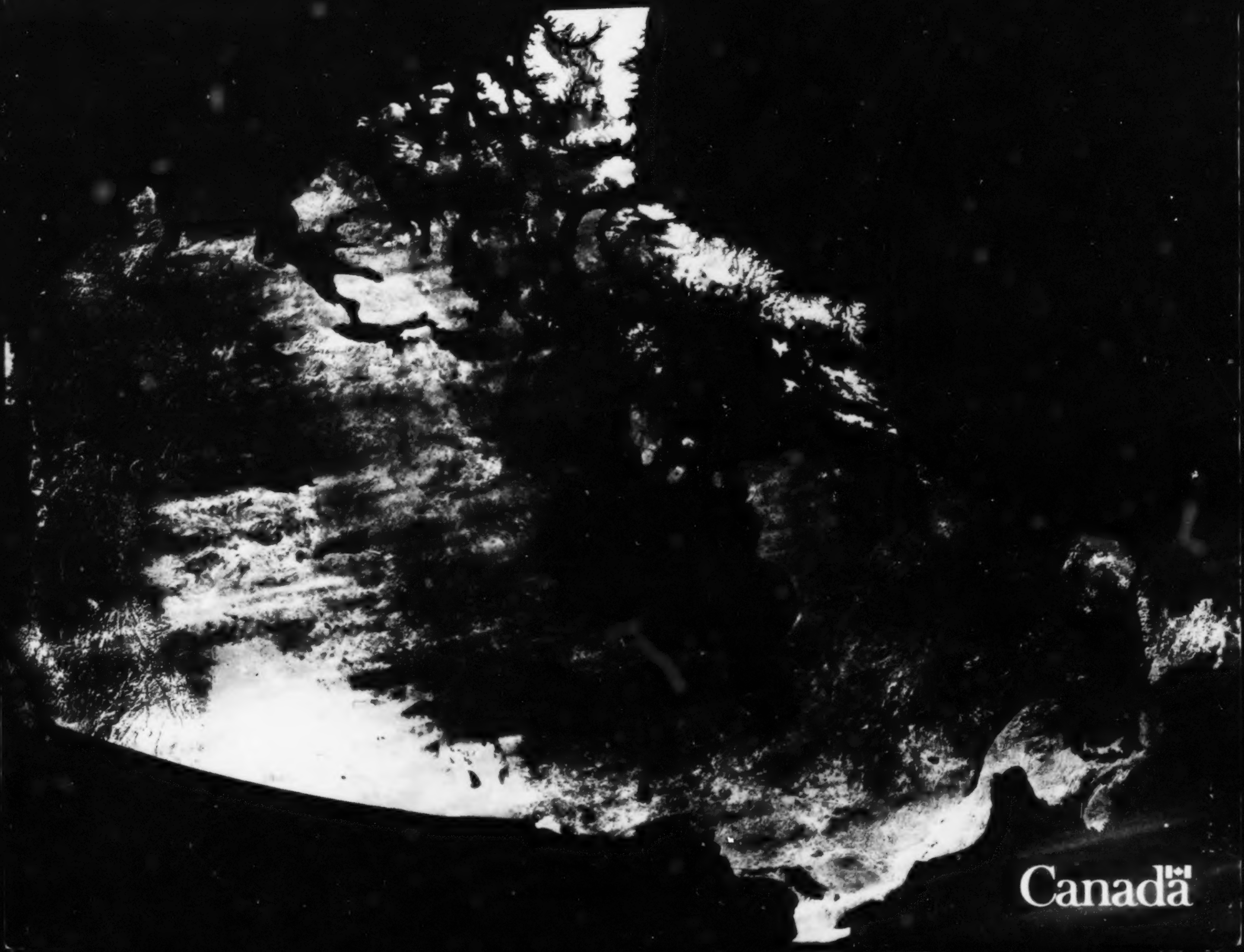
Canadian Minerals Yearbook

2000 REVIEW AND OUTLOOK



Canada

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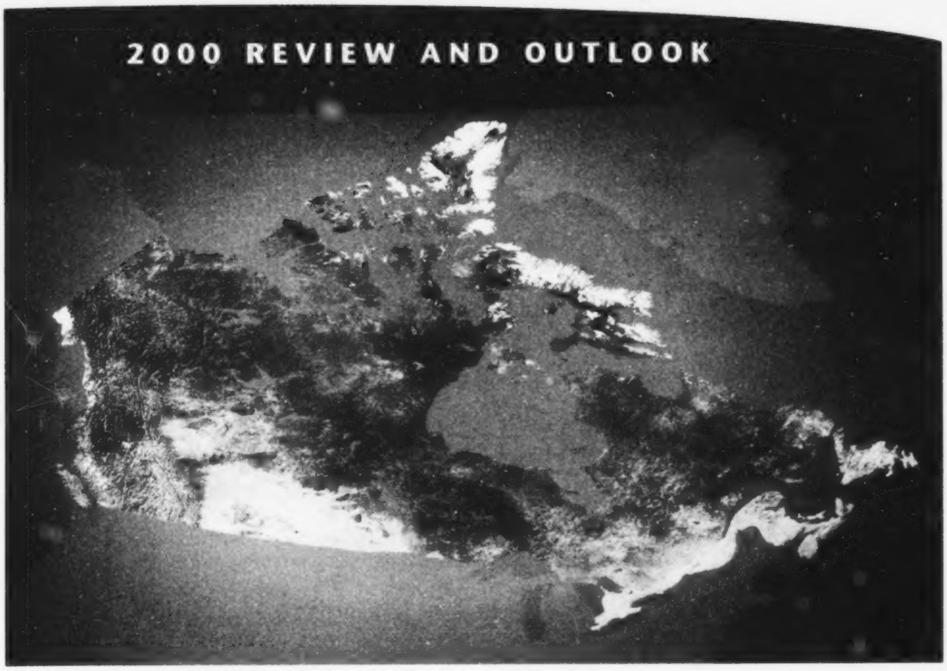
2000 REVIEW AND OUTLOOK

Canada

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Available in Canada through
your local bookseller or by mail from:

Geological Survey of Canada Bookstore
Ottawa, Canada K1A 0E8
Telephone: 1-888-252-4301

Catalogue no. M38-5/49E
ISBN 0-660-18753-1

Published by:
Minerals and Metals Sector
Natural Resources Canada

Telephone: (613) 947-6580
Facsimile: (613) 952-7501
E-mail: info-mms@nrcan.gc.ca

Internet site for MMS: http://www.nrcan.gc.ca/mms/ms-e.htm

Cette publication est aussi disponible en français, sous le titre
Annuaire des minéraux du Canada
2000 : Aperçu et perspectives
N° de catalogue : M38-5/49F
ISBN : 0-660-96652-2

This publication is printed
on recycled paper.

PRINTED IN CANADA

Preface

Each year, the Minerals and Metals Sector of Natural Resources Canada undertakes a comprehensive review of developments in the mineral industry and publishes the results as the *Canadian Minerals Yearbook*. This publication forms a continuing record from year to year, with this edition reporting on the activities of the industry during 2000 (some events in 2001 may be referenced).

The main focus of this publication is the non-fuel mineral industry, together with uranium, although all mineral fuels are normally included when the total value of Canada's mineral production is reported. The Yearbook includes chapters devoted to each major mineral commodity produced in Canada. The subject matter spans all stages of mineral industry activity from geoscience and exploration, through mining and processing, to markets and use. Although domestic issues receive the greatest attention in each chapter, international developments may also be reviewed because of the global nature of the mineral industry and the significant impact that such developments could have on the Canadian industry.

The Yearbook's first chapter, entitled "General Review," highlights the importance of the industry in the context of the Canadian economy. In 2000, the non-fuel mineral industry accounted for approximately 2.7% of total national employment, 3.7% of Canada's Gross Domestic Product, and 12.8% of Canada's total domestic exports. The General Review is followed by chapters that focus on the Canadian scene with reviews on mine reserves and recent production decisions; mineral exploration and discoveries; and mine openings and closings. A chapter that details Canada's global mining presence abroad is also included, as well as a new chapter this year entitled *Canada's Rank in World Mining,* which follows the commodity reviews.

The 17 commodity reviews in this year's edition feature economic and policy developments and data specific to each commodity in respect of markets, prices, production, trade and use. These commodity chapters also provide an outlook of the industry's future position.

The Statistical Report at the end of the Yearbook is a comprehensive set of approximately 50 tables that provide a detailed statistical overview of the mineral industry. These tables are grouped according to the following topics: production; trade; use; prices; principal statistics; employment, salaries and wages; mining and exploration; transportation; and investment and finance. Although the tables focus on the most recent data available, many of the tables also include historical statistics.

The basic statistics on Canada's mineral and metal production, trade and use were collected by the Minerals and Mining Statistics Division of Natural Resources Canada, or by Statistics Canada, unless otherwise noted. Market quotations were taken mainly from published marketing reports. Corporate data presented in the various chapters of this Yearbook were obtained by the authors directly from company officials through surveys or correspondence, or were taken from web sites and annual reports. Natural Resources Canada is grateful to everyone who has contributed information used in the preparation of this publication.

Additional copies of the 2000 Yearbook may be purchased from the Geological Survey of Canada Bookstore (telephone (613) 995-4342 or 1-888-252-4301 [toll free], or e-mail gscbookstore@nrcan.gc.ca) and local booksellers. Previous editions of the *Canadian Minerals Yearbook* have been deposited in various libraries across Canada.

For more information on the products and services available from the Minerals and Metals Sector, visit our web site at http://www.nrcan.gc.ca/mms, or contact us at:

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Note: Previous and current commodity reviews prepared by the Minerals and Metals Sector are also available on our web site at:

http://www.nrcan.gc.ca/mms/cmy/index_e.html

Updates will be posted as they become available.

December 2001

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* The 2000 nickel review contains some textual information and statistical tables on cobalt.

Note: Commodities shown in **bold** type are covered in this issue. The other commodities listed have appeared in previous editions for which the year is indicated in parentheses.

Canadian Minerals Yearbook

2000 Review and Outlook

NOTE TO READERS

The intent of this publication is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The authors and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this publication.

ABBREVIATIONS

The reader should note that a number of abbreviations for common units of measurement appear in the text:

cm	centimetres
ct	carats
ct/t	carats per tonne
ct/y	carats per year
ft	feet
ft^2	square feet
g	grams
GJ/t	gigajoules per tonne
g/t	grams per tonne
h	hour
ha	hectares
kg	kilograms
kgU	kilograms of uranium
km	kilometres
km^2	square kilometres
kWh	kilowatt hours
L	litres
lb	pounds
m	metres
m^2	square metres
m^3	cubic metres
Mct	million carats
mg	milligrams
mg/d	milligrams per day
mm	millimetres
Mt	million tonnes or megatonnes
Mt/y	million tonnes per year
MW	megawatts
oz	ounces or troy ounce
ppm	parts per million
st	short tons
t	tonnes
t/d	tonnes per day
t/h	tonnes per hour
t/m	tonnes per month
t/y	tonnes per year
tU	tonnes of uranium
μg	micrograms
y	year

General Review

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OVERVIEW

Global economic activity was buoyant throughout 2000 although, to a large degree, it was driven by strong sustained demand growth in the United States. Many economies, including Canada's, were being driven by their export sector and the United States was a major destination for these products. In many countries, economic activity was mixed but positive and inflation and interest rates were stable. However, the sharp increase in energy prices during the year, driven mainly by significantly higher global oil prices, and weakening consumer demand were beginning to take effect in the marketplace. Indeed, as early as mid-year, there were signs of economic activity levelling off. By the last quarter of 2000, and particularly in December, it was apparent that a significant adjustment had begun as economic activity slowed noticeably, particularly in the United States.

The strong level of world economic activity evident for most of the year benefited the global mineral industry. Prices for most mineral commodities were strong throughout much of the year and this translated into higher revenue and profits for mineral and metal producers. Under-valuation of assets created opportunities for a number of takeovers and consolidations. Although the profits of Canadian producers were up significantly, the industry was not as profitable as might have been expected. With the exception of platinum and diamond activity, mineral exploration continued to be soft. Higher energy prices increased operating costs significantly. Even though more mines closed than opened, mine employment increased following several years of declines. On the fuel side, although revenues increased substantially due to booming prices for crude petroleum and natural gas, Canadian production increased only modestly.

Canada's real Gross Domestic Product (GDP), measured at market value in 1992 prices, increased by 4.7% to $921.5 billion in 2000 from $880.3 billion in 1999. Both interest rates and inflation remained low during 2000, although slightly higher than those experienced in 1999. These factors, combined with employment growth, led to an unemployment rate of 6.8% at the end of 2000, the same rate as at the beginning of the year, but considerably lower than the 1999 average of 7.6%. The value of the Canadian dollar vis-à-vis the U.S. dollar remained weak and closed the year at $0.6669, down from $0.6888 at the start of 2000. Total Canadian exports increased to $417.7 billion, up 15.8% from 1999, while total imports rose by 11.1% in 2000 to $36[illegible].2 billion.

The estimated value of production for all sectors of the mining and fuel extraction industry showed an incredible increase of 55.9% from $54 billion in 1999 to $84 billion in 2000. This level set a record for the value of Canadian mineral production, topping the previous all-time high established in 1999. This increase was due principally to the significantly higher prices for crude petroleum and natural gas that prevailed during 2000. When fuels are excluded, the value of production for the mining industry increased by 8.3% to $18.5 billion from $17.1 billion in 1999. Of this, metals increased by 13.1% and nonmetals increased by 1.8%. **(The above figures are for domestically mined minerals and do not include the value of primary aluminum production because it is produced from imported bauxite ore, nor do they include the value of recycled material.)**

The value of domestic exports for non-fuel mining and mineral processing products rose to $49.1 billion (including coal), a 10% increase over 1999. This represented 12.8% of Canada's total domestic exports. Canadian imports of non-fuel mining and mineral processing products, including coal, rose by 13.9% to $50.7 billion, resulting in a small merchandise trade deficit (total exports minus total imports) of $255 million in 2000.

Prices for the major metal commodities opened the year on a strong note and rose, peaking, in most cases, in the third quarter of the year. Subsequently, the major nonferrous metals (nickel, copper, zinc, lead and aluminum) actually finished the year at prices lower than at the start of the year. Gold and silver prices peaked earlier in the year; however, palladium and platinum ended the year on an exceptionally strong basis with the price of palladium approaching US$1000/oz and platinum at over US$600/oz.

Significant developments affecting the Canadian mineral industry in 2000 included:

- excellent financial performances, particularly by the major integrated companies;
- generally firm mineral commodity prices throughout the year, but softening towards year-end;
- strong mineral development activity continuing in Canada's diamond industry, including the announcement of the decision to develop Canada's second diamond mine;
- a continuing impasse at the Voisey's Bay nickel development in Labrador;
- consolidation in ownership of major Canadian mining operations;
- active exploration for platinum and diamonds while overall exploration activity remained flat;
- more mine closings than openings;
- increased mine employment; and
- increased operating mine and processing costs because of significantly higher energy costs.

OUTLOOK AND IMPACTS ON THE CANADIAN MINING INDUSTRY

The outlook for the Canadian mining industry in 2001 is clouded by the sharp weakening of the U.S. economy and, to a lesser degree, of the Canadian economy in the last quarter of 2000. Positive economic growth, but significantly less than during the past several years, is still expected, although the possibility of a mild recession remains. Several quarters may be needed to deplete excess inventories in many sectors of the North American economy. The slowdown in the United States will also have an impact on the health of the global economy as many national economies depend on exports to the United States, including Canadian mineral and metal producers. Mineral commodity prices, in general, are expected to remain relatively stable for most of the year. Globally, corporate consolidations and ongoing mining cost reductions have eliminated some high-cost production and large-capacity, low-cost projects are coming on stream, notably for copper, gold and nickel. The reduction in high-cost operations would be even more striking if the local currencies of most major producing countries were not so weak relative to the U.S. dollar. Major metal prices, despite lower inventories, were not high at the beginning of 2001 and will not respond to upward pressure on prices until consumer and investor-owned inventories overhanging the market are eliminated. Higher petroleum and natural gas prices drove up the demand for thermal coal in 2000 and the price was up in early 2001 by some 15% to about US$33/t. As well, a contraction in the supply of metallurgical coal over the past several years has led to an increase in early 2001 of about 7.5% in the Japanese reference price to US$42.75/t. Iron ore prices for standard fines were up by 4.3% for 2001 Japanese reference contracts.

Based on company spending intentions for 2001, exploration expenditures are expected to remain soft. For many companies, diamonds and platinum group metals are the only targets of interest. With the price of gold trading in the US$260-$280/oz range for much of 2000, new low-cost, large gold projects scheduled to come on stream, and official sales (sales from gold reserves) still taking place, gold exploration is not attracting the investor interest that it normally does.

The Toronto Stock Exchange (TSE) continued to be the world's leading stock exchange for raising equity for mining companies in 2000, although the number of mining companies listed declined in 2000. At the end of the year, 245 companies were listed with a market capitalization of $67 billion. This compares to nearly 300 companies in 1999 with a capitalization of $80 billion.

CANADIAN ECONOMY

The Canadian economy performed well as GDP grew by 4.7% in 2000 compared to 4.5% in 1999. Although by recent standards interest rates and inflation remained at low levels, the trend in 2000 was edging towards higher interest rates and increasing levels of inflation. The Bank of Canada raised its bank rate by 25 basis points in February, another 25 basis points in March and a further 50 basis points in May, bringing the rate to 6.00% where it remained for the rest of the year. The annual inflation rate averaged 2.7% for 2000, up from 1.7% for all of 1999, but rose to an annualized rate of 3.2% late in the year, a mark just outside the Bank's annual target range of 1-3%. Consumer confidence and spending remained firm. Canada Mortgage and Housing Corporation announced that housing starts increased by 1.1% in 2000 to 151 700 units. According to Statistics

Canada, the value of building permits reached $37.0 billion in 2000, an increase of 3.4% over 1999. Of this amount, residential homes accounted for $20.3 billion, an increase of 1.9% from 1999. The Canadian Real Estate Association estimates that house sales across Canada on the Multiple Listing Service declined fractionally from 334 043 in 1999 to 333 198 in 2000. Sales of new vehicles in Canada rose by 3.2% to 1.55 million. Canadian automotive producers announced the production of 2.9 million motor vehicles in 2000, down 2.3% from 1999 levels.

CANADIAN ECONOMIC CONDITIONS

Leading Indicators	1999	2000	% Change
Real GDP ($ billion, 1992 prices)	880.3	921.5	+4.7
Consumer prices (% annual change)	+1.7	+2.7	n.a.
Operating profits ($ millions)	168.3	197.7	+17.5
Unemployment rate (% annual average)	7.6	6.8	−10.5
Merchandise trade balance ($ billion)	38.4	59.3	
Housing starts (000)	150.0	151.7	+1.1
U.S. exchange rate (annual average)	0.6730	0.6733	+0.04
International current account balance ($ millions)	1 690	26 894	n.a.
Global economic output (% change)	+2.5	+3.3	n.a.

Source: Natural Resources Canada.
n.a. Not applicable.

Employment in Canada rose by 325 000, or some 2.2%, in 2000, down from 427 000, or 3.0% growth, in 1999. The unemployment rate at the end of December 2000 was 6.8%, the same rate that was in effect 12 months earlier at the end of 1999.

On the trade front, total merchandise exports continued to grow, reaching $417.7 billion in 2000, an increase of 15.8% over 1999. Despite an increase in imports, Canada's trade surplus rose to $54.5 billion, up from a surplus of $33.8 billion in 1999 and $19.1 billion in 1998. The 2000 surplus contributed to Canada's overall international current account surplus of $26.9 billion. At year-end the Canadian dollar was trading at 66.7¢ in U.S. funds, down from 68.9¢ at the beginning of the year. The average value of the dollar for the year was 67.3¢.

Global economic activity increased strongly in 2000 to an estimated 4.8% growth rate, up from 3.5% in 1999. The U.S. economy continued to perform well with 5.0% growth, up from 4.2% in 1999. The European Union increased by 3.4%, up from 2.6% in 1999, with Germany growing strongly from 1.4% in 1999 to 3.1% in 2000. The South American economies grew at a 2.7% rate in 2000 compared to 0.1% in 1999. China's growth continued with an 8% growth rate in 2000, up from 7.1% in 1999, while Japan showed growth of 1.5% compared to 0.8% in 1999. However, as 2000 came to a close, there were indications that growth had begun to slow in many economies.

The Canadian mining and mineral processing industries can be characterized by the following four stages of processing activity:

- Stage 1: Mineral extraction and concentrating (for example, gold mining, sand and gravel quarrying);
- Stage 2: Smelting and refining (for example, nonferrous smelting and refining, alloying, and the production of primary steel);
- Stage 3: Nonmetals and metals-based semi-fabricating industries (for example, copper rolling, casting and extruding, and concrete products); and
- Stage 4: Metals fabricating industries (for example, manufacturing of ornamental metal products and machine parts).

While much of the emphasis of this article focuses on Stage 1 activities (the activities of the mining industry), a description of the mineral industry as a whole (Stages 1 to 4) provides a more comprehensive picture of the importance of this industry to Canada. In the context of this article, the mineral industry should be taken to exclude the extraction and processing of crude petroleum and natural gas, but to include both the coal and uranium mining industries.

CANADIAN MINERAL INDUSTRY

Leading Mining Indicators	1999	2000	% Change
Value of non-fuel mineral production (with coal) ($ millions)	18 586	19 843	+6.76
Exploration expenditures ($ millions)	504.3	473.4	−6.1
Metal Prices Index (1992=100)			
Precious metals	85.9	85.3	
Base metals	80.5	97.9	
Direct mining employment (000)	53.3	54.0	+1.2
Value of mineral and mineral product exports including coal ($ billions)	44.6	49.1	+10.0
Mining company operating profits ($ billions)	1.4	3.1	+122.8
Mine financing ($ billions) (Gamah International)	5.3	5.8	+10.1

Source: Natural Resources Canada.

GDP OF THE MINERAL INDUSTRY

In 2000, the mineral industry, as defined above, contributed $27.9 billion, or 3.6% of Canada's total GDP of $786.9 billion. This is an increase of 2.1% over 1999. (In this section, all figures are based on GDP at factor cost and at 1992 prices.) Mining and quarrying contributed 26.9% of the industry's GDP in 2000 while smelting and refining and primary steel production added a further 14.9% to the total. Nonmetals and metals-based semi-fabricating accounted for 24.6% and metals fabricating accounted for the remainder at 33.6%.

For mining only (Stage 1), increases in the GDP in 2000 were exhibited by iron mines (up 16% to $514 million) and potash (up by 10.5% to $853 million), whereas coal declined by 5.3% to $944 million. The GDP for services incidental to mineral extraction rose by 41.9% to $3.5 billion in 2000, probably due to increased activity in the oil and gas sector. The GDP for the other stages increased in 2000 relative to 1999 – Stage 2 was up 1.0% to $4.2 billion, Stage 3 was up 1.4% to $6.9 billion, and Stage 4 was up 3.6% to $9.4 billion.

Because these figures are based on 1992 prices, an increase in the value of production indicates an increase in the volume of goods produced. These proportions can be somewhat misleading, however, in that they are based on 1992 prices. Because current price data by industry are only available up to 1997, they do not reflect commodity prices as they were in 2000.

CANADIAN MINERAL PRODUCTION

Based on preliminary estimates, the total value of Canadian mineral production (including fuels) reached $84.2 billion in 2000, an increase of 55.9% over 1999. Of this total, $65.7 billion was attributable to fuels, reflecting the significantly higher prices received for crude oil and natural gas produced in 2000. The non-fuels portion of the total also contributed to the increased value of total Canadian production, rising by 8.3% to $18.5 billion.

CANADIAN MINERAL INDUSTRY VALUE OF PRODUCTION

	1999[r]	2000[p]	Change
	($ millions)		(%)
Metallic minerals	9 796.5	11 078.9	13.1
Nonmetalllic minerals	7 315.4	7 448.5	1.8
Total non-fuels	17 111.9	18 527.4	8.3
Fuels	36 899.7	65 698.6	78.0
Total	54 011.6	84 226.0	55.9

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates* cat. no. 26-202-XIB.
[p] Preliminary; [r] Revised.
Note: Numbers may not add to totals due to rounding.

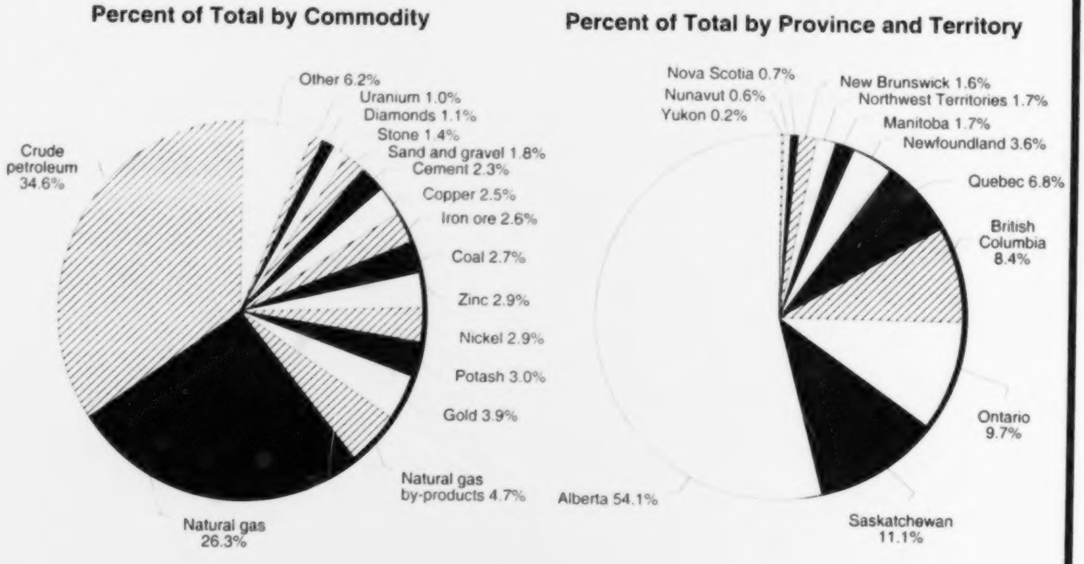
The value of metal production increased by 13.1% to $11.1 billion in 2000 from $9.8 billion in 1999 as significant increases occurred in the value of nickel, copper and platinum group metals. Nickel production rose by 2.4%, but substantially higher prices led to a 48.1% increase in value to $2.4 billion, making it the highest-value non-fuel mineral produced in Canada in 2000. Copper production rose by 7.2% and, coupled with slightly higher prices, led to a total value of $1.7 billion. Platinum group metals had a strong year, rising in value to $464.5 million, an increase of 85.5% over 1999, despite only a small increase in the volume of production of 11.3%. Prices increased dramatically; the price of palladium, for example, more than doubled during the year to over US$950/oz at the end of the year.

Gold was Canada's second leading metal with a value of output of $2.0 billion. This was a decrease of 2.6% compared to 1999 and reflected a 2.4% decline in production. Gold and nickel were the only two metals produced in Canada with a value of production over $2 billion in 2000. Among the value of other metals, zinc increased by 1.7% to $1.5 billion (although production was down by 2.9%), iron ore increased by 9.6% to $1.5 billion (production was up by 5.1%), uranium declined by 7.7% to $485 million (production was down by 2.3%), silver declined by 5.8% to $277.3 million (production fell 1.1%), cobalt declined by 10.0% to $101.1 million (even though production remained virtually the same), lead fell by 17.3% to $95.8 million (production was down by 7.9%), and molybdenum increased by 8.1% to $64.4 million (production increased by 9.3%).

The value of production for nonmetals (including structural materials) increased to $7.4 billion in 2000, a rise of 1.8% over 1999. Increases in the value of potash, cement and diamonds more than offset the declines in salt, asbestos and gypsum. The value of production for potash increased by 4.9% to $1.7 billion as production rose by 7.5%, reflecting firmer demand for fertilizer products. Although the construction industry was buoyant in Canada during 2000, the experience of the major construction materials was mixed. Cement rose to $1.3 billion, up 2.2%, with production falling fractionally by 0.2%; sand and gravel declined by 0.2% to $956.2 million with production increasing by 1.6%; and stone increased by 6% to $821.9 million while production was up by 2.9%. Diamonds rose in value to $638.2 million, an increase of 5.3% over 1999. Production increased by 5.3% as Canada's only diamond mine completed its second full year of production.

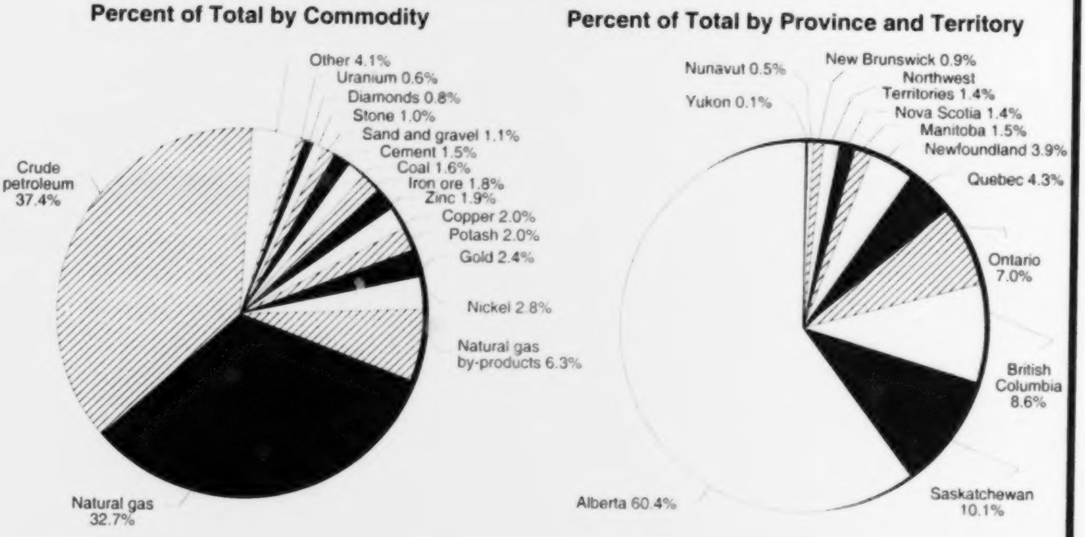
Figure 1
Value of Mineral Production, Percent Shares by Commodity and by Province and Territory, 1999 and 2000

1999
$54.0 Billion



Percent of Total by Commodity **Percent of Total by Province and Territory**

2000
$84.2 Billion



Percent of Total by Commodity **Percent of Total by Province and Territory**

Sources: Natural Resources Canada; Statistics Canada.

Notes: The provincial shares may not add to 100% due to rounding. Prince Edward Island's share is excluded as it is too small to be expressed.

Among other nonmetals, salt declined by 7.3% to $346.5 million (production declined by 5.9%), lime was up fractionally by 0.6% to $240.2 million (production was down by 0.7%), asbestos was down 10.6% to $143.9 million (production was down 5.0%), elemental sulphur was up by 1.4% to $98.4 million (production was down by 1.6%), and sulphur in smelter gas was down by 5.8% to $54.5 million (even though production was up by 0.7%).

The value of production for mineral fuels increased dramatically in 2000 from $36.9 billion to $65.7 billion, a rise of 78.0%. Sharply higher international prices for crude oil and higher prices for natural gas in North America led to significant increases in the value of Canadian production. On the production side during 2000, coal was down by 4.6% while natural gas was up by 2.4%, natural gas by-products were up by 2.8% and crude oil was up by 7.7%.

Based on the value of production for 2000, the top non-fuel commodities were nickel ($2.4 billion), gold ($2.0 billion), potash ($1.7 billion), copper ($1.7 billion), zinc ($1.6 billion), iron ore ($1.5 billion) and cement ($1.3 billion). In terms of the production of Canada's leading minerals, increases in output in excess of 5% were recorded for copper, iron ore, platinum group metals, molybdenum, potash and diamonds, whereas declines of 5% or more were experienced by lead, salt, asbestos and gypsum (Table 1).

Geographically, the importance of the industry may be more significant on a regional and community basis as, in many parts of Canada, particularly in the North, it provides a major economic stimulus. Well over 100 communities were heavily reliant on mining in 2000 and approximately 600 000 Canadians lived in these communities.

Regionally, four provinces continued to dominate the value of Canada's non-fuel mineral output in 2000, accounting for slightly more than 73% of the total. Ontario contributed the largest share of the non-fuel mineral output at 30.8% of the total value while Quebec contributed 19.5%, Saskatchewan, 11.9%, and British Columbia, 11.2%. For the other provinces and territories, Newfoundland accounted for 5.6%, New Brunswick for 4.1%, the Northwest Territories for 3.8%, Alberta for 3.5%, Nunavut for 2.1%, Nova Scotia for 1.2%, and the Yukon for 0.3%. The value for Ontario increased by 11.3% to $5.7 billion, Quebec was down fractionally by 1.1% to $3.6 billion, Saskatchewan was up 1.3% to $2.2 billion, and British Columbia was up 25.5% to $2.1 billion. When coal is included, the value of Saskatchewan production climbs to $2.3 billion, up 1.1% from 1999, and the value of B.C. production increases by 14.5% to $2.8 billion.

Alberta is Canada's major mineral fuels producer with a value of production of $50.2 billion in 2000, which accounted for 76.4% of Canada's total. Alberta produces a full complement of mineral fuels: crude petroleum, natural gas, natural gas by-products and coal. Other provinces with significant mineral fuels production are Saskatchewan with 9.6% and British Columbia with 7.9% of Canada's total. Newfoundland accounted for 3.4% and the other provinces and territories accounted for the remaining 2.8%.

Of the six mine openings in 2000, two were in Quebec (gold and asbestos) and there was one in each of Ontario (gold), Manitoba (zinc), the Northwest Territories (gold) and Nunavut (gold). Of the thirteen closings, five were in Quebec (two gold, two copper and one wollastonite), three were in Alberta (coal), two were in Ontario (gold), two were in British Columbia (asbestos and coal), and one was in Manitoba (gold).

METAL AND MINERAL COMMODITY PRICES

The strength of metal and mineral commodity prices experienced for most of 1999 continued into 2000 in response to the ongoing robustness of the global economy. The GDP for the world economy is estimated to have increased by 4.8% in 2000, up from 3.5% in 1999.

Prices for the major base metals opened strong in 2000 and increased during most of the year before peaking, in most cases, in the third quarter. The notable exceptions were aluminum, which peaked in January, and nickel, which hit its high in March. With the slowdown in economic activity in the last quarter of the year, the major nonferrous metals (nickel, copper, zinc, lead and aluminum) finished the year at prices lower than at the start, despite metal exchange inventories at or near their lows for the year.

Based on trading on the London Metal Exchange, nickel opened the year at US$3.74/lb with inventories at 47 304 t and ended the year at US$3.26/lb with inventories at 9678 t. Nickel hit its high of US$4.84/lb in March and its low of US$3.20/lb in December. Demand for nickel for use in stainless steel was strong, particularly during the first six months, and the nickel market was affected by events that had an impact on the supply at various times during the year. Copper opened the year at US85.4¢/lb, fell to US77.2¢/lb in March, peaked at US91.1¢/lb in September and declined to US82.0¢/lb by year-end. Copper inventories began the year at 789 975 t and ended it at 357 225 t as automotive and construction demand for copper remained strong for most of the year. Zinc began 2000 at US55.0¢/lb, moved up to US57.9¢/lb in September and, by year-end, had reached its low for the year at US46.3¢/lb. Inventories of zinc declined to 194 775 t by the end of the year from 279 050 t at the start. Galvanized steel demand (a major use of zinc) was strong until the latter part of the year while, overall, global demand-supply for zinc came more into balance in 2000.

Lead prices remained within a narrow range for the year, opening at US21.5¢/lb and closing the year at US21.4¢/lb, having peaked at US23.5¢/lb in September and hitting their low of US18.1¢/lb in April. Lead inventories opened the year at 176 675 t and fell to 130 650 t by year-end. Globally, the demand for batteries continued to be firm and lead exports from China remained strong. Aluminum began the year at US73.3¢/lb, peaked at US79.2¢/lb later in January, dipped to its low in April of US63.4¢/lb, and recovered to end the year at US70.8¢/lb. Aluminum inventories declined by over half during the year, beginning at 771 275 t in January and ending 2000 at 321 850 t. Demand for aluminum by the automotive industry was strong for most of the year. Besides the slowing of economic activity towards the end of the year, aluminum market dynamics were affected during the year by corporate consolidations and smelter cutbacks caused by the energy crisis on the west coast of the United States.

For precious metals, gold closed out the year at US$272.65/oz, down from US$281.50/oz at the start of 2000. Although gold hit US$312.70/oz in mid-February, gold prices were negatively affected by ongoing official sales of gold, principally the regular gold sales by the Bank of England, notwithstanding the September 1999 *Washington Agreement* under which European banks agreed to limit gold sales. Gold dropped to its low for the year in October at US$263.80/oz. Hedging, a general lack of investor interest, and continuing efforts by producers to lower mining costs also weighed on the market. However, companies operating in certain countries (e.g., Australia) benefited from the strength of the U.S. dollar as gold prices rose in terms of local currency. Silver began the year at US$5.30/oz, hit its high of US$5.37/oz in late January, and then declined steadily to US$4.58/oz on the last trading day of 2000. By year-end, the United States Defense National Stockpile Center delivered the last of its remaining stockpile of silver to the United States Mint for coinage. Palladium was again affected by uncertainty of supply from Russia, which currently supplies about two thirds of the market, and the price skyrocketed to reach US$970/oz in late December. The price began the year at US$443/oz, declined slightly to US$433/oz, finished the year at US$954/oz, and then hit US$1085/oz in mid-January 2001. Platinum prices, which averaged about US$440/oz in January, hit a high of US$622/oz in December 2000 and finished the year at US$611/oz, up 37.9% for the year, but significantly less than the price level reached by palladium.

For other mineral commodities, the spot price for uranium (U_3O_8) was quoted at US$7.10/lb at the end of 2000, a decline of 26% from US$9.60/lb at the beginning of the year. During the same period, long-term contract prices for uranium fell by about 10% to US$9.25/lb. At year-end, high-grade cobalt was selling at about US$13.50/lb. Entering 2000, sulphur price quotations on a free on board (f.o.b.) basis were between US$35 and US$39/t. Quotations rose to US$40-$42/t by February and then plateaued until June when they started to show some weakness. By the end of 2000, prices had decreased to US$30-$32/t, largely in response to increased competition from Middle Eastern producers in some of Canada's traditional markets. Quoted prices for potash, f.o.b. Vancouver, were unchanged from 1999 at US$110-$129/t for standard grade and US$128-$132/t for granular. Coal prices, which are largely determined by Japanese reference contracts, declined in 2000. High-grade metallurgical coal for export declined by 5% to US$39.75/t while export thermal coal fell by 4% to US$28.75/t. Japanese iron ore reference prices increased, with the price for fines increasing by about 4.3% and the price for lump ore increasing by about 5.8%. Pellet prices for European markets were up by just under 6%.

RESERVES

Canadian reserves of copper, molybdenum, lead, nickel, silver and gold decreased significantly during 1999 and zinc reserves maintained the same level as at the end of 1998. Because prices were lower in 1999 than in 1998, the ore reserve calculations used by companies resulted in ore reductions at many operations. Lower metal prices reduce the level of reserves because lower-grade reserves become uneconomical to mine and are removed from reserves. However, production is normally the main factor reducing the reserves at individual mines. Mine closures also contribute to reducing reserve levels. Canadian reserves of copper, nickel, lead, zinc, molybdenum and silver have declined steadily since the early 1980s, and gold began a gradual decline in the late 1980s.

EMPLOYMENT IN THE MINERAL INDUSTRY

Combined employment in the four stages of the mineral industry (including coal mining) is estimated to have reached 401 400 in 2000, 3.7% above the revised 1999 level of 387 200. The mineral industry thus accounted for approximately 2.7% of the national employment level of 14.9 million (full and part-time) in 2000.

Employment in Stage 1 (metals and nonmetals, including structural materials and coal mining) increased for the first time since 1995. Employment was estimated at 54 000 in 2000, an increase of 1.2%

over 1999. Employment in metal mining increased by 2.1%, in nonmetal mining by 0.8%, and in structural materials by 6.5%, the latter reflecting continuing strength in construction activities. The closure of some coal mining operations led to a 7.8% drop in coal mine employment during 2000.

Employment levels for Stages 2, 3 and 4 were all higher in 2000 compared to the previous year. Employment in Stage 2 increased by 1.6% to 61 200, with gains in the smelting and refining sector offsetting decreases in the iron and steel sector. Stage 3 employment rose by 5.0% to 101 832 with gains in the semi-fabrication activities involving steel pipe and tube, aluminum and copper. Stage 4 employment in metallic mineral manufacturing increased by 4.3%. The strong North American economies contributed to these employment increases.

The level of employment in the sector that provides services incidental to mining, quarries or oil and gas wells increased by 12.4% to 45 647 in 2000. The sector provides drilling services, conducts exploration, and provides other services. In 2000, the number employed in diamond drilling related to mining was 1819, the same as in 1999. Because there is no establishment-based survey undertaken at this time by either Natural Resources Canada or Statistics Canada for Services Incidental to Mining, these numbers should be viewed with caution.

MINERAL INDUSTRY TRADE

Canada is one of the world's largest exporters of minerals and metals, and the export of these commodities and more refined mineral products has a significant impact on Canada's overall merchandise balance of trade, and hence on the national standard of living. In 2000, the value of domestic exports of minerals and mineral products, including fuels, increased by 37.8% to $98.9 billion from $71.8 billion in 1999 (Table 2). The increase was largely due to a substantial increase in the value of mineral fuels. All four stages of production showed increases, with the largest increase being in Stage 3.

Again in 2000, the United States was by far the leading destination for Canada's minerals and mineral product exports (non-fuel, but including coal) of $49.1 billion; it was the destination for 78.1% of domestic exports. Japan at 4.0% and the United Kingdom at 2.5% followed. The top 20 countries accounted for 97.2% of total domestic exports. Based on the four stages of production, exports to the United States accounted for 35.9% of Stage 1, 77.1% of Stage 2, 85.3% of Stage 3, and 92.2% of Stage 4.

The value of total domestic exports of metallic minerals and mineral products increased by 13.2% to $37.9 billion in 2000, up from $33.5 billion. On a commodity basis, an increase in the value of exports was seen for aluminum (11.2%), copper (20.6%), iron and steel (12.6%), nickel (44.9%), and platinum group metals (67.6%). Uranium exports fell by 13.4% and gold exports declined by 7.9%. Two commodities, iron and steel and aluminum, accounted for 50.2% of these exports in 2000. The value of Stage 1 domestic exports for metallic commodities rose by 12.7% to $3.6 billion. For individual commodities in Stage 1, domestic exports increased for copper (75.5%), platinum group metals (105.3%), iron and steel (14.4%), and aluminum (7.3%), while exports fell for lead (-24.0%) and gold (-19.6%). Three commodities (iron ore, aluminum and copper) represented 58.5% of all Stage 1 metallic exports.

The total value of domestic exports of nonmetallic minerals and mineral products rose to $8.1 billion, up by 2.1% from $7.9 billion in 1999. Gains were experienced in the value of exports of potash and potassium compounds (15.1%), sulphur and sulphur compounds (4.2%), and glass and glassware (3.9%). Exports that declined in 2000 were gypsum (-38.0%) and nitrogen (-2.2%). Potash and potassium compounds accounted for 30.0% of all nonmetallic exports.

Domestic exports of structural materials (now part of nonmetallic minerals) increased in value during 2000 to $1.2 billion, an increase of 9.8% from $1.1 billion in 1999. The value of cement exports, which accounted for 61.1% of total structural exports in 2000, rose by 1.5% to $746.8 million. Gains were experienced by granite (12.8%), dolomite (33.1%), marble, travertine and other calcareous stones (45.6%), and other nonspecified structural materials (46.1%).

Significant increases in domestic exports of petroleum and natural gas led to a value of $51.6 billion in 2000 for fuel exports, an increase of 76.7% over 1999 as sharp price increases for these commodities were experienced during the year. Domestic exports of coal and coke declined by 11.0% in 2000 to $1.8 billion. Petroleum accounted for 53.5% of total fuel exports with natural gas accounting for 39.0%.

The value of imports of mineral products, including fuels, increased by 25.4% from $54.9 billion in 1999 to $68.9 billion in 2000. Excluding fuels, but including coal, imports of mineral products amounted to $50.7 billion with shipments from the United States accounting for 68.9% of this total. Mexico at 3.5%, China at 2.8% and Japan at 2.6% followed. The top 20 countries accounted for 93.7% of total imports. For the four stages of production, imports from the United States accounted for 65.6% of Stage 1 imports, 48.7% of Stage 2 imports, 65.5% of Stage 3 imports, and 73.8% of Stage 4 imports.

The total value of metal imports increased by 15.0% to $41.2 billion in 2000 with increases in iron and steel (10.7%), aluminum (12.6%) and copper (101.8%)

leading the way. These three commodities accounted for 61.8% of all metals imports in 2000. For nonmetals, imports were up by 10.4% to $6.8 billion from $6.2 billion in 1999, led by glassware (13.0%), phosphate and phosphate compounds (25.0%), and abrasives (6.3%). Graphite imports dropped by 6.8%. Glass and glassware accounted for 41.7% of all nonmetal imports by value in 2000. The value of imports of structural materials in 2000 amounted to $1.5 billion, an increase of 8.6% over $1.4 billion the previous year. Clay and clay products, which accounted for two thirds of total structural imports in 2000, increased by 9.6% to $979.5 million. Fuel imports were up by 67.6% as the value of petroleum imports rose by 76.9%. Petroleum accounted for 89.3% of total fuel imports in 2000.

Higher values of imports of mineral products, particularly from Stage 4, led to a negative balance of trade in 2000 of $255.0 million. This compares to a positive balance of $1.2 billion in 1999 and $2.7 billion in 1998. For the total economy, the trade surplus rose to $54.5 billion in 2000 from $33.8 billion in 1999 and $19.1 billion in 1998 as higher exports exceeded the increase in imports.

INVESTMENT BY THE MINERAL INDUSTRY

Information on exploration expenditures and capital spending provides a useful indication of market conditions and of the view held by management and investors in the Canadian mining industry on future market conditions in relation to present productive capacity. In 2000, based on year-end valuations, 245 mining companies were listed on the Toronto Stock Exchange with a market capitalization of $67 billion, compared to approximately 300 companies with capitalization of $80 billion in 1999.

Exploration Expenditures

Final exploration data for 1999 show that exploration and deposit appraisal expenditures amounted to $504.3 million, compared to $655.9 million in 1998. Preliminary estimates for 2000 indicate a decline to $473.4 million. Company spending intentions for 2001 show a further drop to $457.7 million. Exploration for palladium, diamonds and tantalum continue to be bright spots. Enhanced flow-through share incentives announced by the Government of Canada in late 2000 and additional incentives from the provinces and territories may help stimulate more interest in future exploration activities.

With the exception of Nunavut, Manitoba and New Brunswick, all provinces and territories experienced declines in exploration and deposit appraisal expenditures in 2000.

Mine complex development expenditures (including capital and repair expenditures) were $3.0 billion in 1999. Preliminary figures for 2000 show an increase of 4.4% to $3.1 billion. Company forecasts are estimated at $3.3 billion in 2001, a rise of 6.4%. Ontario and Quebec are expected to have the largest expenditures in both years, although expenditures in the Northwest Territories have increased dramatically from $88.9 million in 1999 to an anticipated $324.7 million in 2000 and $619.5 million in 2001.

The level of mineral exploration activity is closely linked to mineral commodity prices, so it is not unexpected that, when prices are depressed, exploration expenditures decline. When commodity prices show signs of strength, the mineral exploration industry can be expected to respond with increased activity.

Capital Investment

Capital expenditures for construction and materials and equipment in the mining and mineral processing industries are estimated to reach $7.1 billion in 2000, up from $6.4 billion in 1999. Company spending intentions are expected to fall to $5.9 billion in 2001. Capital expenditures for the mining and quarrying industry (Stage 1) are estimated at $2.6 billion in 2000, up 6.8% from $2.5 billion in 1999. A decline to $2.4 billion is anticipated in 2001. Capital investment in the primary metals and mineral semi-fabricating industries (Stages 2 and 3) rose to $3.5 billion in 2000, up from $3.1 billion in 1999, an increase of 13.6%. In 2001, company spending intentions indicate a decline to $2.6 billion. Fabricated metals (Stage 4) rose to $924.9 million in 2000, up 10% from $840.7 million in 1999, and a slight decline to $918.9 million is indicated for 2001.

In 1999, capital investment in the total economy stood at $171.3 billion. Estimates indicate an increase to $179.9 billion in 2000 and $183.1 billion in 2001. In 1999, investments in the mineral industry (Stages 1 to 4) accounted for 3.7% of the total capital expenditures in the Canadian economy. This is estimated at 3.9% in 2000 and it could fall to 3.2% in 2001. When repair expenditures to structures, machinery and equipment are included, expenditures in the mining and mineral processing industries totaled $10.8 billion in 1999, the latest year for which repair data are available. The 1999 level represented 5.1% of the total capital and repair expenditures within the Canadian economy.

HIGHLIGHTS IN THE CANADIAN MINING INDUSTRY

Corporate Developments

Profits for the industry were markedly higher in 2000 due in large part to higher base-metal prices for most of the year. Corporate operating profits for the mining industry increased by 122.8% to $3.1 billion from $1.4 billion in 1999. In 1998, profits were $1.1 billion.

The formal decision to bring Canada's second diamond mine into production, the Diavik diamond project at Lac de Gras, located some 35 km southeast of the Ekati mine (Canada's first diamond mine), and 300 km north of Yellowknife in the Northwest Territories, was announced in December 2000. The project is a joint venture between Diavik Diamond Mines Inc. (DDMI), a wholly owned subsidiary of Rio Tinto plc, and Aber Diamond Mines Ltd., a wholly owned subsidiary of Aber Diamond Corporation. DDMI owns 60% of the project and is the project operator with Aber owning the remaining 40%. The positive production decision follows the receipt of a bankable feasibility report in May 2000 and brings into effect the environmental agreement with the Government of Canada, the Government of the Northwest Territories (GNWT), respective Aboriginal groups and DDMI; the socio-economic monitoring agreement between GNWT and DDMI; and participation agreements between Aboriginal groups and DDMI. The estimated $1.3 billion project is now targeted to come into production in early 2003 based on a construction schedule commencing in early 2001. The current mining plan calls for four kimberlite pipes to be mined (A-154 South, A-154 North, A-418 and A-21), with production to come initially from surface mining and then move to underground mining for A-154 South and A-418 as these pits deepen. In mid-2000, total proven and probable reserves of the four pipes were estimated at 25.7 Mt with an average grade of 4.2 ct/t at a price of US$74/ct. Aber has indicated its intentions to market its 40% share of Diavik production, including operating its own diamond sorting facility. As well, Aber has announced a business relationship with diamond manufacturer Overseas Diamonds N.V. and a marketing alliance with Tiffany & Co., which includes an agreement to sell the jeweller at least US$50 million worth of diamonds annually over a 10-year period.

A potential third Canadian diamond mine made strong progress during 2000. Indeed, at year-end, DeBeers Canada Mining completed the acquisition of the Snap Lake project, a diamondiferous kimberlite dyke prospect, with the purchase of Aber Diamond Mines Ltd.'s 32.2% interest for $173 million. Several months earlier, DeBeers acquired an initial 67.8% stake through the $305 million takeover of Winspear Diamonds Inc. The project is located in the Camsell Lake region of the Northwest Territories, some 220 km northeast of Yellowknife. During 2000, prefeasibility work continued as underground exploration and development moved the project further along towards a production decision. In April 2000, a pre-feasibility study indicated a mineable resource equivalent to 22 million recoverable carats with a value of US$118/ct, with capital costs estimated at $269 million for a 3000-t/d underground operation. Later in July, Winspear announced an updated scoping study that recalculated the estimated recoverable diamonds to a depth of 750 m at 67 million ct. As well, at mid-year, the company confirmed an extension to the size of the dyke.

In May, North American Palladium Ltd. (NAP), Canada's only primary platinum group metals producer, embarked on a $208 million expansion plan, buoyed by high prices for both palladium and platinum. The decision followed the expansion of resources and reserves of palladium and associated metals in 1999 and the receipt of a positive feasibility report to ramp up palladium production from the property. A new mill, rated at 15 000 t/d, was under construction and is scheduled to come on stream in mid-2001 to replace the existing 2400-t/d mill. Development of the expanded open pit to feed the concentrator was under way at mid-year. The company estimates that, beginning in 2002, it will produce 250 000 oz of palladium per year at a cash cost of US$160/oz, making it the lowest-cost primary palladium producer in the world. NAP has announced that it now sells 100% of its palladium production to a major automotive manufacturer under a five-year contract. The purchase prices are at a minimum of US$325/oz on 100% of production and a ceiling price of US$550/oz on 50% of production, based on average monthly London Metal Exchange prices. There is no upper limit price on the other half of production.

Also in May, Breakwater Resources Ltd. acquired the Bouchard-Hébert and Langlois zinc mines from Cambior Inc. for $48 million. The sale of the two mines, located in the Abitibi region of northwestern Quebec, was part of Cambior's financial restructuring plan, which was required to satisfy the significant losses incurred from gold hedging programs in 1999. When its restructuring program is completed, Cambior indicated that it will focus on gold mining as it has retained all of its core gold assets. With this new strategy, the company will be better able to develop its gold properties and to participate in the consolidation process expected in the gold sector.

Goldcorp Inc.'s new Red Lake gold mine began pouring gold in August, following settlement in April of a long-running strike that was settled with agreement by union members to decertify the union. Throughout the strike, development work continued and the company was successful in finding and outlining high-grade gold resources and reserves. Subsequently, the mine had its official opening in October with commercial production announced as of January 1, 2001. The underground mine and surface mill have a design production rate of 545 t/d and production in 2001 is forecast to be in excess of 300 000 oz. The company announced in January 2001 that reserves are now calculated at 1.8 Mt grading 1.69 oz/t with an inferred resource of 435 000 t grading 2.02 oz/t using a price of US$275/oz, thus making it one of the richest operating gold mines in the world.

In September, the Joint Review Panel of the Alberta Energy and Utilities Board and the Canadian Environmental Assessment Agency recommended that the Cheviot coal mine project in Alberta receive regulatory approval from the Government of Canada. The project, a joint venture between Luscar Coal Ltd. and CONSOL of Canada Inc., is located near Hinton and is expected to produce over 3 Mt of metallurgical coal for export markets. Although the Panel recommended that the project should proceed in 1997, a federal court directed that the Panel reconvene in early 2000 to hear additional evidence. By year-end, although a federal response to the Panel's recommendation had not yet been forthcoming, the Government of Alberta reissued a new mine permit for the project. Subsequently, in April 2001, the project received federal government acceptance.

In October, Noranda Magnesium, owned 100% by Noranda Inc., announced that the Magnola magnesium plant, located at Danville, Quebec, had produced its first ingots of magnesium metal. The project, with an estimated cost of approximately $840 million and owned 80% by Noranda Magnesium and 20% by Société générale de financement du Québec, is expected to begin commercial production in the second half of 2001. Its capacity is rated at 63 000 t/y of magnesium output using Noranda-developed technology to extract magnesium from serpentine mine tailings.

Major consolidation activities had an impact on the Canadian mineral industry in 2000. Rio Tinto plc became the major owner of the Iron Ore Company of Canada Limited (IOC) as a result of its acquisition of North Ltd., which owned 56.1% of IOC. Later in the year, Rio made an offer, through its wholly owned subsidiary, Rio Tinto Canada Inc., to buy all units of the Labrador Iron Ore Royalty Income Trust, the owner of 18.9% of IOC, and royalty and commission fees paid on IOC sales. The offer is estimated at approximately $405 million. Mitsubishi Corporation owns the remaining 25% of IOC. Inco Limited was successful with its $200 million offer to buy back its Class VBN shares that were issued as part of its purchase of the Voisey's Bay nickel-copper-cobalt deposit in Labrador in 1996. As a result, Inco now has total control over the deposit. Noranda Inc. announced late in 2000 that, as a result of additional purchases of Falconbridge Limited shares, its ownership of Falconbridge had reached approximately 55%, up from 49.9% at the end of 1999. Also in 2000, Teck Corporation increased its ownership in Cominco Ltd. to 50.1%, due in part to a general offer to Cominco shareholders. Billiton Copper Holdings Inc., a wholly owned subsidiary of Billiton plc, was the successful purchaser of Rio Algom Limited, paying approximately $1.7 billion for the company in the latter part of 2000. The successful bid topped a lower bid by Noranda Inc.

The development of the Voisey's Bay nickel-copper-cobalt orebody was suspended in January 2000 as talks with the Government of Newfoundland and Labrador about a mining licence for the project officially broke down. The Government reiterated its position that all of the ore had to be processed in the province, whereas Inco would not commit to anything that might prove to be uneconomic. In early 2001, with a new premier in place for the provincial government and a new chief executive appointed for Inco, formal talks began between the Government of Newfoundland and Labrador and Inco on potential development of the project. The company is developing a special hydrometallurgical process that could be used to process the sulphide nickel ore found at Voisey's Bay. The process, still at the laboratory stage, would have to be tested as a pilot project. If successful, the process would allow Inco to process ore within the province and thus fulfill the province's key demand that the nickel be processed in Newfoundland before being shipped out of the province.

Other important events in 2000 included a strike by the Canadian Auto Workers Union (Mine/Mill Local 598) against the Sudbury operations of Falconbridge Limited, which began on August 1, 2000, idling four nickel-copper mines and mill and smelter operations. The nearly seven-month-long strike was settled in February 2001. Late in the year, Teck Corporation announced an agreement to sell its 50% ownership in the Niobec niobium mine in Quebec (50% owned by Cambior Inc.) to Mazarin Inc. for $47 million. Mazarin has also agreed to purchase Teck's 25% interest in the Oka niobium project for $3 million, subject to Niocan Inc.'s consent. In the last quarter of the year, Agnico-Eagle Mines Limited completed another expansion of the mill at its LaRonde gold mine, raising capacity to 4535 t/d. As a result of this increase in capacity, the company expects to be able to produce at a rate in excess of 300 000 oz of gold per year by the end of 2001.

Industry and Government Initiatives

The Government of Canada, spearheaded by Natural Resources Canada, in conjunction with provincial governments, the territories and the mineral industry, has undertaken a number of activities to promote and support Canada's minerals and metals industry and mining-related equipment and services sectors. In 2000, these included:

- The announcement, in the 2000-2001 Budget, of the allocation of $15 million over three years for the new Targeted Geoscience Initiative (TGI) to ensure that Canada's geological information infrastructure continues to be state-of-the-art to stimulate new investment in mineral exploration. In collaboration with provincial and territorial geological surveys, TGI projects were initiated in nine provinces and the three territories.

- Asian Trade Mission in January 2000: The Minister of NRCan – accompanied by some 70 resource-based companies, three provincial ministers, and Aboriginal and municipal leaders – led a successful trade mission to China, South Korea and Japan. This mission laid the groundwork for the successful participation in the Prime Minister's Team Canada mission to China in February 2001.

- European Mission in September 2000: The Minister of NRCan led a departmental delegation to Brussels and Berlin to meet with decision-makers in the European Commission, the German government and the Canadian and European business communities. The visit signaled to the European Union (EU) the value that the Government of Canada places on the bilateral relationship, opened better channels of communication and information exchange, and laid the groundwork for more timely Canadian engagement in various EU legislative and regulatory processes.

- Development of geographic information systems (GIS): This will help northern and Aboriginal communities with the use of technology and developing data that will aid them in making decisions about their environment and economic resources.

In its 2000-2001 budget presented in March 2000, Quebec extended until December 31, 2001, the maximum 175% deduction of certain qualifying exploration expenses in certain locations for provincial tax purposes.

The Ontario Budget of May 2000 included initiatives that have an impact on mining activities in Ontario. The province is reducing the mining tax rate from 20% to 10% and enacting a 10-year tax holiday for new mines in remote areas aimed at promoting development in the Far North and in distant Aboriginal communities. As well, it is encouraging investment in mineral exploration by enacting a 30% tax deduction for Ontario residents who own flow-through shares for mineral exploration and reducing the corporate tax rate from 15.5% to 8.5%. In December the province indicated that it would harmonize its tax incentives with those of the federal government by offering a 5% refundable tax credit that, in dollar terms, is equivalent to the previously announced 30% tax deduction.

In July 2000, as a result of amendments to the federal *Income Tax Act*, British Columbia announced that the 20% refundable Mining Exploration Tax Credit to companies could be passed on to flow-through share investors retroactive to August 1, 1998.

In October, the Canadian Industrial Energy End-Use Data and Analysis Centre (CIEEDAC), an independent authority on industrial climate change performance, released information that, for the combined metal mining (less iron ore) and nonferrous metal smelting and refining sectors, energy consumption in 1998 was 13.5% less than 1990 levels and 1.2% less than 1997. With respect to greenhouse gas emissions, which include direct and indirect emissions, 1998 emissions for the same sectors were 16.4% less than 1990 levels and 8.8% less than 1997 levels.

In the Economic Statement and Budget Update of October 18, 2000, the Government of Canada proposed that a temporary 15% income tax credit be made available to individual investors who incur, either directly or through a partnership, exploration expenses pursuant to a flow-through share agreement. The expenses must be incurred by a corporation in the period after October 17, 2000, and before January 1, 2004, and must be for grassroots exploration conducted from or above surface.

On November 6, 2000, the Yukon announced that from April 1, 2001 to April 1, 2002, it would increase its refundable tax credit to companies from 22% to 25% of eligible mineral exploration expenditures.

In December, The Mining Association of Canada (MAC) announced the 1999 survey results for the Accelerated Reduction/Elimination of Toxic Substances (ARET) initiative, a voluntary program for individual Canadian companies. For the mining and metal processing companies that participate in this MAC survey, all ARET substances remain below the 1992 base-case levels and all, but possibly copper and arsenic, are expected to meet the original 50% target reduction by 2000. The reductions achieved to 1999 are arsenic, -49%; cadmium -71%; copper, -28%; hydrogen sulphide, -62%; lead, -73%; mercury, -93%; nickel, -78%; and zinc, -81%.

PROFILES OF THE LEADING MINERALS PRODUCED IN CANADA

Gold

Canada has long been one of the world's leading producers of gold. In 1999 (the latest year for which world data are available), Canada trailed only South Africa, the United States, Australia and China in the production of this precious metal. In 2000, Canada's gold output decreased from 157.6 t to 153.8 t, a decline of 2.4%. The value of gold shipments decreased by 2.6% to $2.0 billion. The average price of gold improved slightly to US$279.03/troy oz in 2000, but is still low by historical standards. The gold price closed out the year at US$272.65/oz and, for the first part of 2001, is averaging about

US$270/oz. Gold prices have been adversely affected by official sales of gold, although the 1999 *Washington Agreement*, under which European banks agreed to limit sales through 2004, has brought some stability to the market. Hedging, a general lack of investor interest, and a strong U.S. dollar have also weighed on the market. In an effort to reduce production costs, the relatively fragmented gold mining industry has been consolidating, and will continue to consolidate, with several mergers already announced and more expected.

Although Canadian gold production declined in 2000, employment increased to an estimated 8387, compared to just over 8200 in 1999. The 2000 employment level, however, remains lower than the recent peak of 10 100 in 1997.

Copper

The volume of copper produced in Canada increased by 7.2% in 2000 to 623 500 t, an increase attributable to the re-opening of two mines temporarily closed in 1999. This amount was still below the 690 800 t produced in 1998. Copper prices fluctuated around US80¢/lb for the first half of the year, then rose, peaking to average nearly US89¢/lb in September. The average price for 2000 was US82.3¢/lb, an increase from the 1999 average of US$71.3/lb. The price of copper has declined over the first half of this year and was trading at just over US70¢/lb.

Copper's properties, especially its high electrical and thermal conductivity, good tensile strength, relatively high melting point and resistance to corrosion, make it and its alloys attractive for electrical transmission, water tubing, castings and heat exchangers. World use is expected to increase by about 3% in 2001, down from over 6% in 2000, based on slower demand in western Europe and Asia, strong demand in Mexico, and a slower increase in copper use in the United States. A number of promising new applications for copper in the construction, transportation and electrical and electronics industries could provide significant growth opportunities.

Zinc

Canada is the world's third largest producer of zinc, trailing China and Australia in 1999. Zinc is used in the automotive and construction industries for the galvanization of steel and manufacture of die-cast alloys, in the production of brass, in semi-manufactures such as rolled zinc, and in chemical applications. In 2000, zinc production (recoverable zinc in concentrates shipped) declined by 2.9% to 935 700 t. As older mines near closure, zinc production in Canada is expected to decrease further in 2001. Zinc prices averaged US51.2¢/lb in 2000, a 4.9% increase over 1999. Over the first six months of 2001, prices have averaged US44.3¢/lb. For 2001, the zinc market is expected to be in surplus for the Western World market.

Nickel

Canada is the world's second largest nickel producer, behind Russia and ahead of Australia and New Caledonia. Nickel's resistance to corrosion, high strength, pleasing appearance and suitability as an alloying agent are characteristics that make it useful in many applications. Major markets include stainless steel (which uses about 65% of nickel production), nickel- and copper-based alloys, electroplating, alloy steels, and foundry products.

In 2000, nickel production in Canada increased by 2.4% over 1999 to 181 000 t. The value of nickel produced in 2000 rose dramatically by 48.1% to $2.4 billion. Nickel prices averaged US$3.92/lb in 2000, substantially above the 1999 average of US$2.73/lb. The price was supported by increased stainless steel demand and lower-than-expected production from some Australian projects. For the first half of 2001, the price has retreated and averaged US$3.00/lb for that period. Currently, the price is US$2.76/lb. The global nickel industry is relatively small and is dominated by several large producers. This often leads to price volatility as large new projects come on stream or delays caused by unexpected technical problems curtail production. For the next few years the price is expected to average in the US$2-$4/lb range.

Iron Ore

Iron ore production levels in Canada increased by 5.1% in 2000 to 35.7 Mt. The value of production increased by 9.6% to $1.54 billion. Over 80% of the volume and 75% of the value of iron ore mine shipments are exported. The United States was the largest single customer, receiving 34% of the shipments in 2000. The EU was the recipient of 53% of shipments of Canadian iron ore in 2000.

The situation in the iron ore market improved substantially during the second half of 1999 and into 2000. Japanese steel production surged in the first half of 2000, resulting in increases in the Japanese iron ore reference prices with the price of fines rising by about 4.3% and the price of lump ore rising by about 5.8%. Pellet prices for European markets were up by just under 6%. Further price increases are forecast for 2001.

Another factor is aiding iron ore producers in their negotiations with major consumers. Iron ore freight rates have risen sharply, giving consumers less scope to seek better prices from producers farther afield.

Uranium

Canada is the world's largest producer and supplier of uranium, exporting about 80% of its production. The United States is the largest market for Canadian uranium. The world's two largest uranium-producing companies have operations in Canada. Uranium production in Canada declined by 2.3% in 2000 to 9919 t. (Production is defined as the metal content [U] reported by producers of uranium precipitates or concentrates.) Despite this decline, uranium still ranks solidly among Canada's top 10 metal commodities in terms of value of production (in 2000, $485.3 million). World uranium (U_3O_8) spot prices were quoted at US$7.10/lb at the end of 2000, a significant decline from US$9.90/lb at the beginning of the year. The price has since risen, averaging US$7.72/lb for the first quarter of 2001.

Potash

The term "potash" refers to a group of potassium-bearing minerals and chemicals. The dominant potash product is potassium chloride, a naturally occurring pink, salty mineral for which Canada is the world's leading producer and exporter. Fertilizer use consumes over 90% of output. Other uses include detergents, ceramics, chemicals and pharmaceuticals. In 2000, potash was the third most valuable non-fuel mineral produced in Canada, trailing only nickel and gold. In 2000, the value of potash produced in Canada totaled $1.71 billion, a 4.9% increase over 1999. The potash industry in Canada employed about 3400 workers in nine underground mines and two solution mining operations in Saskatchewan and in New Brunswick in 2000.

Canada is the world's largest potash exporter with a 43% share of international trade. Canada ships to some 40 countries but, in 2000, the United States purchased 58% of the total. Together with China (13%) and Brazil (8%), these three markets accounted for almost 80% of export sales.

Quoted prices for potash, f.o.b. Vancouver, were unchanged from 1999 at US$110-$129/t for standard grade and US$128-$132 for granular.

It is estimated that world potash deliveries will decline 7% to 23.5 Mt (K_2O equivalent) in 2001 compared to 2000.

Diamonds

In its first full year of production, Canada's only diamond mine produced 2.4 million ct valued at $606.3 million. In 2000, the second year of operation, the Ekati mine in the Northwest Territories produced 2.6 million ct valued at $638.2 million. A formal decision to bring Canada's second diamond mine into production, the Diavik diamond project at Lac de Gras, located about 35 km from the Ekati mine, was announced in December 2000. The project is now targeted to come into production in early 2003, based on construction commencing in early 2001. A potential third mine, the Snap Lake project, also in the Northwest Territories, made strong progress in 2000.

Exploration for diamonds continued in several regions of Canada during 2000, although at a somewhat slower rate than in 1999. Preliminary data indicate that diamond exploration expenditures decreased from $109 million in 1999 to about $94 million in 2000. Exploration was focused principally in the Northwest Territories, but Ontario, Nunavut and Alberta also attracted significant diamond exploration activity, as did Saskatchewan, Manitoba and Quebec.

OUTLOOK

The outlook for the Canadian mineral industry was unclear as 2001 began, although it was becoming more apparent that global economies were slowing down. This was particularly evident in the United States, where the economy grew at a weaker pace in the last three months of 2000 – a 1.1% annual rate as consumers reduced their spending and companies reacted to softening demand by curtailing investment activity and reducing high inventory stockpiles. Since the United States is a major market for Canadian metals and minerals, if this slowdown in growth continues into 2001 as is now expected, Canadian exports of these materials and the performance of Canadian producers will be negatively affected. Reflecting this slowdown in global activity, most major metal prices early in 2001 were at the low end of their range of the past 18 months, although Japanese reference prices for metallurgical coal, thermal coal and iron ore were higher.

Although steelmaking, a major user of metals and minerals, was holding up reasonably well in terms of production on a global basis, profitability was a major concern and more producer consolidations are likely. In North America, steelmaking had slowed noticeably in the last half of 2000, due in part to a reduction in automobile production and a large influx of steel imports that U.S. and Canadian steelmakers claimed were dumped or imported at subsidized prices. Formal trade actions to evaluate these allegations are under way. A continued reduction in steel production in the United States and Canada will have a negative impact on the Canadian minerals industry.

Most economists are forecasting Canadian GDP growth of about 2.1% in 2001, down from 4.7% in 2000. Inflation is expected to be at the upper limit of the Bank of Canada's 1-3% target range, with energy price pressures pervading the economy. The Bank of Canada reduced its bank rate by 0.25% to 5.75% in

January 2001, the first reduction in the rate since May 1999, indicating that the reduction was necessary taking into account the Canadian economic outlook and a reduction in the corresponding U.S. interest rate. Subsequently, further 0.25% decreases brought the Canadian bank rate down to 4.5% by the middle of 2001.

Globally, forecasters are looking at GDP growth of about 3% in 2001, down from 4.8% in 2000. A 3.8% growth rate is forecast for 2002. The United States is forecast to decline from 5% growth in 2000 to about 1.8% in 2001. Western Europe is expected to experience growth of about 2.3% in 2001 and South America about 2.9%, both figures lower than in 2000. Japan, after growing modestly by 1.5% in 2000, is forecast to show no growth in 2001. Growth rates in Southeast Asia should average about 3.5%, well below the rates achieved in 2000.

Canadian mining companies will continue to be under pressure to reduce costs in order to stay competitive in the global marketplace and to generate acceptable returns to investors. New mine development, other than for diamonds, will continue to be weak. Exploration activity, with the exception of diamonds and platinum group metals, can be expected to be flat at best. Notwithstanding this, mining in Canada will continue to make a major contribution to the Canadian economy in 2001.

Notes: (1) Information in this review was current as of August 31, 2001. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. CANADA, PRODUCTION OF LEADING MINERALS, 1999 AND 2000^{p}

		Volume		Percent Change	Value		Percent Change
		1999^{r}	2000^{p}	2000/1999	1999^{r}	2000^{p}	2000/1999
		(000 tonnes except where noted)			($ millions)		
METALS							
Gold	kg	157 617	153 781	–2.4	2 099	2 045	–2.6
Copper		582	623	7.2	1 366	1 688	23.5
Iron ore		33 990	35 707	5.1	1 406	1 541	9.6
Zinc		963	936	–2.9	1 540	1 567	1.7
Nickel		177	181	2.4	1 592	2 358	48.1
Uranium	tU	10 157	9 919	–2.3	526	485	–7.7
Silver	t	1 174	1 161	–1.1	295	277	–5.8
Platinum group	kg	13 872	15 439	11.3	250	464	85.5
Cobalt	t	2 014	2 013	0.0	112	101	–10.0
Lead		155	143	–7.9	116	96	–17.3
Molybdenum	t	6 250	6 833	9.3	60	64	8.1
NONMETALS, INCLUDING STRUCTURAL MATERIALS							
Potash (K_2O)		8 475	9 107	7.5	1 634	1 714	4.9
Salt		12 686	11 935	–5.9	374	347	–7.3
Peat		1 180	1 194	1.2	164	168	2.4
Asbestos		337	320	–5.0	161	144	–10.6
Sulphur, elemental		8 656	8 515	–1.6	97	98	1.4
Sulphur in smelter gas		843	849	0.7	58	55	–5.8
Diamonds	000 carats	2 429	2 558	5.3	606	638	5.3
Gypsum		9 345	8 548	–8.5	107	96	–10.1
Nepheline syenite		676	703	4.0	57	61	5.6
Cement		12 634	12 612	–0.2	1 232	1 259	2.2
Sand and gravel		242 369	246 331	1.6	958	956	–0.2
Stone		109 184	112 348	2.9	775	822	6.0
Lime		2 565	2 547	–0.7	239	240	0.6
Clay products		. .	. .	. .	165	175	6.5
MINERAL FUELS							
Petroleum, crude	000 m^3	122 247	131 631	7.7	18 698	31 503	68.5
Natural gas	million m^3	162 219	166 078	2.4	14 192	27 581	94.3
Coal		72 497	69 149	–4.6	1 474	1 315	–10.8
Natural gas by-products	000 m^3	28 805	29 600	2.8	2 535	5 299	109.1

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, cat. no. 26-202-XIB.
. . Not available; ^{p} Preliminary; ^{r} Revised.
Notes: Numbers have been rounded. Percent changes are based on unrounded data.

TABLE 2. CANADA, VALUE OF DOMESTIC EXPORTS, TOTAL EXPORTS (INCLUDING RE-EXPORTS), IMPORTS, AND BALANCE OF TRADE OF MINERALS AND MINERAL PRODUCTS, STAGES I TO IV, 1996-2000

	1996	1997	1998	1999	2000
			($000)		
TOTAL MINING, INCLUDING FUELS					
Domestic exports	67 867 537	71 497 524	68 382 983	71 790 654	98 893 225
Total exports	69 082 166	72 967 314	69 521 400	72 960 781	100 368 715
Imports	42 333 331	49 987 070	53 304 329	54 912 684	68 851 291
Balance of trade	26 748 835	22 980 244	16 217 071	18 048 097	31 517 424
NON-FUEL MINING					
Domestic exports	39 368 642	41 714 560	42 810 682	42 572 850	47 275 875
Total exports	40 078 786	42 544 308	43 799 223	43 600 825	48 585 507
Imports	31 494 434	37 138 246	42 501 584	43 360 799	49 488 [illegible]
Balance of trade	8 584 352	5 406 062	1 297 639	240 026	–903 390
TOTAL NON-FUEL MINING, INCLUDING COAL					
Domestic exports	41 989 016	44 449 130	45 333 223	44 617 186	49 096 321
Total exports	42 700 792	45 279 935	46 322 761	45 648 649	50 408 065
Imports	32 251 990	38 017 410	43 643 110	44 477 285	50 663 023
Balance of trade	10 448 802	7 262 525	2 679 651	1 171 364	–254 958
TOTAL ECONOMY					
Domestic exports	259 265 000	281 255 740	297 509 000	331 346 516	384 131 878
Total exports	275 773 600	299 089 922	322 517 000	360 608 800	417 657 600
Imports	232 648 033	277 751 100	303 420 400	326 820 900	363 163 500
Balance of trade	43 125 567	21 338 822	19 096 600	33 787 900	54 494 100

Sources: Natural Resources Canada; Statistics Canada.

Canadian Reserves of Selected Major Metals, and Recent Production Decisions

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RESERVES OF SELECTED MAJOR METALS

Canadian reserves of copper, molybdenum, lead, nickel, silver and gold decreased significantly during 1999. Only zinc reserves were maintained at the same level as at the end of 1998 (Table 1).

Declining metal prices during 1999 caused many mining companies to make their ore reserve calculations at year-end based upon lower metal prices than they had used at the end of 1998. This resulted in reductions in ore reserves at most producing mines and a number of mine closures.

In Canada during 1999, there were only two announcements of new production decisions for the seven metals reviewed in this chapter. Given that metal prices were generally depressed during 2000, it is probable that Canadian ore reserve levels for the major metals will continue to decline in the immediate future. The Voisey's Bay nickel-copper-cobalt deposit in Labrador is not presently included in Canadian reserves because there are major issues to be resolved before production can begin. When a production decision is made, it will result in significant increases in the reserves of nickel and copper.

Reserves Policy

Canadian reserves are estimated from information contained in annual and other corporate reports, and from the responses of mining companies to the annual Federal-Provincial Survey of Mines and Concentrators.

Reserves reported here include only metal contained in material that is classified by companies as "proven" or "probable" (or their equivalents) at producing mines and in deposits that are firmly committed to production (Table 2). Metal contained in mineral resources classified by companies as "possible" (or its equivalents) is not included in national totals, nor is metal contained in deposits that have not advanced beyond the deposit appraisal phase (Figure 1). When available, only metal contained in mineable ore is included in Canadian totals to exclude losses inherent in the mining process. Every effort is made to achieve, from year to year, consistency in the reserves reported here; however, consistency ultimately depends on industry practice, which has evolved over the years. Imperial units reported by companies have been converted to metric units and the results have been rounded to the appropriate number of significant digits.

Reserves by Commodity

Gold

There were 1326 t of gold contained in Canadian mine reserves in December 1999. This represents a decrease of 7% (89 t) compared to revised totals for December 1998. The major components of this decrease were the closure of Royal Oak Ontario Division as a result of the bankruptcy of Royal Oak Mines Inc. and the depletion of reserves without replacement at the Doyon mine (-15 t) and the Troilus mine (-12 t) in Quebec, at the Golden Giant mine (-12 t) in Ontario, and at the Kemess South (-12 t) and Highland Valley mine (-12 t) in British Columbia. Notable increases in gold reserves were reported at the LaRonde mine (+66 t) and the Sigma #1 mine (+19 t) in Quebec, at the Musselwhite (+19 t) and Red Lake mines (+13 t) in Ontario, and at the 777 mine (+22 t) in Manitoba.

Silver

There were 15 368 t of silver contained in Canadian mine reserves in December 1999. This represents a decrease of 2% (370 t) compared to revised totals for December 1998. The major components of this decrease were the depletion without replacement of reserves at the Highland Valley (-471 t) and Eskay Creek mines (-198 t) in British Columbia. The only silver-producing mines to significantly increase their reserves during 1999 were the LaRonde mine (+843 t) in Quebec and the 777 mine (+310 t) in Manitoba.

Figure 1
Generalized Model of the Mineral Resource Development and Mining Process

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRONMENTAL RESTORATION
		GRASSROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine development, construction of processing plant and infrastructure.	Production, marketing and renewal of reserves.	Mine complex closure and decommissioning, site restoration.
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest", to justify more intensive and detailed work.	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically.	Obtain all the information required and determine, based on corporate objectives, parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustainable development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new targets.	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Pre-feasibility studies.	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Pre-feasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommissioning. Environmental restoration and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%; mining: ± 5%)		Full compliance
INVESTMENTS	Moderate	Low, but increasing multiple investments.					Larger and increasing multiple investments.				Very large industrial investment.		
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss.					High, but decreasing risk of failure.				Moderate to low industrial risk.		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

Zinc

During 1999, Canadian reserves of zinc remained essentially unchanged at about 10.2 Mt. Zinc reserves decreased at the Brunswick No. 12 mine (-260 000 t) in New Brunswick, at the Sullivan mine (-109 000 t) in British Columbia, and at the Polaris mine (-94 000 t) in Nunavut. The only major increases in zinc ore reserves during 1999 were at the LaRonde mine (+378 000 t) in Quebec and at the 777 mine (+414 000 t) in Manitoba.

Lead

Canadian reserves of lead decreased by approximately 14% during 1999 to 1 586 000 t. This was largely because of the production without replacement of ore at the Brunswick No. 12 mine (-120 000 t) in New Brunswick, at the Sullivan mine (-74 000 t) in British Columbia, and at the Polaris mine (-22 000 t) in Nunavut.

Copper

In December 1999, Canadian reserves of copper were estimated at about 7.8 Mt, or down by about 7% (-594 000 t) from a year earlier. Copper reserves were reduced at Inco Limited's Ontario Division (-380 000 t) and at the Highland Valley mine (-126 000 t) in British Columbia. Copper reserves were increased at the LaRonde mine (+65 000 t) in Quebec and at the 777 mine (+263 000 t) in Manitoba.

Molybdenum

Canadian reserves of molybdenum stood at 119 000 t in December 1999, or about 2% lower than in the previous year. This decrease was due to the depletion without replacement of the reserves at the Endako (-3000 t) and Huckleberry (-1000 t) mines, which were only partially offset by the increase at the Highland Valley mine (+2000 t). All of these mines are in British Columbia.

Nickel

In December 1999, there were some 5.0 Mt of nickel contained in Canadian mine reserves, down by approximately 12% from 1998 levels. This decrease is due largely to reduced reserves at Inco's Ontario Division (-661 000 t) and at Falconbridge Limited's Sudbury operations (-68 000 t), also in Ontario.

Inco had some 4.1 Mt of nickel in Canadian reserves at the end of 1999, or about 82% of the national total. It is expected that development of the copper-nickel-cobalt deposits at Voisey's Bay in Labrador will make major additions to Canada's mineable reserves of these metals in the near future.

Canadian Reserves by Province and Territory

Four provinces (Ontario, British Columbia, New Brunswick and Quebec) held dominant positions in terms of Canada's proven and probable mineable reserves of major metals in December 1999 (Table 4).

Ontario had 68% of the nickel, 48% of the gold and 49% of the copper, plus 19% of the silver and 17% of the zinc.

British Columbia had 100% of the molybdenum, 33% of the copper and 28% of the silver, plus 10% of the lead, 8% of the zinc and 17% of the gold.

New Brunswick had 80% of the lead, 32% of the zinc and 25% of the silver, plus 2% of the copper and 2% of the gold.

Quebec had 29% of the zinc, 24% of the gold, 9% of the copper, 11% of the nickel and 24% of the silver.

Manitoba had 21% of the nickel, 9% of the zinc and 5% of the gold, plus 7% of the copper and 4% of the silver.

The Yukon had less than 1% of the gold and less than 1% of the silver.

The Northwest Territories had 1% of the gold.

Nunavut had 5% of the lead, 5% of the zinc, 1% of the gold and 1% of the silver.

Canadian Reserves by Industry

Canadian mines are, to a large extent, polymetallic, a complexity that the Standard Industrial Classification (SIC) tends to oversimplify (Table 5).

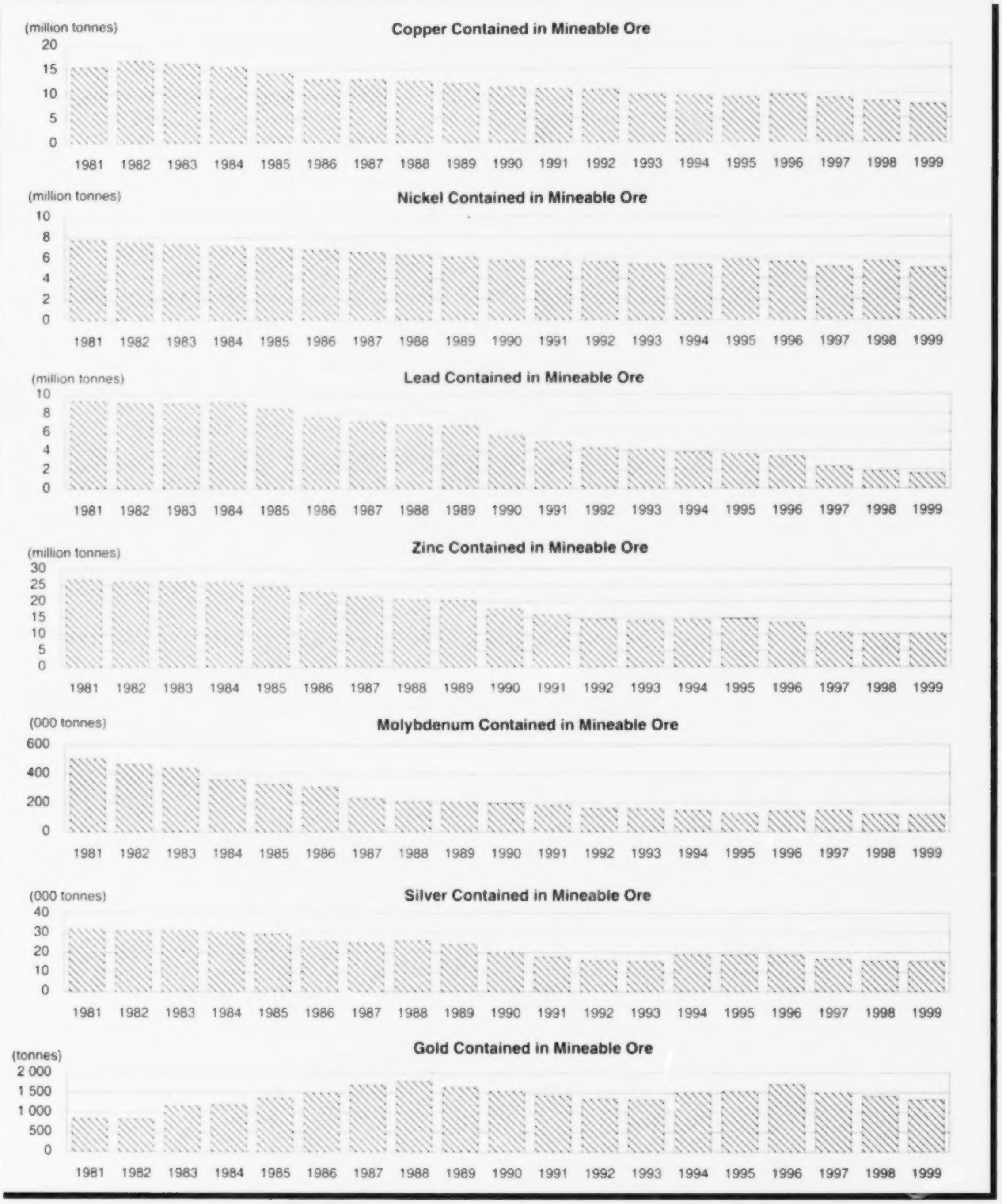
Current mine reserves of gold in Canada are distributed through the various SIC classes as follows: gold mines, 79%; copper and copper-zinc mines, 15%; nickel-copper mines, 3%; and zinc-lead-silver mines, 2%.

Current mine reserves of silver in Canada are distributed through the various SIC classes as follows: gold mines, 39%; copper and copper-zinc mines, 27%; nickel-copper mines, 3%; and zinc-lead-silver mines, 27%.

Current mine reserves of copper in Canada are distributed through the various SIC classes as follows: gold mines, 2%; copper and copper-zinc mines, 53%; nickel-copper mines, 42%; and zinc-lead-silver mines, 2%.

Current mine reserves of molybdenum in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 36%; and molybdenum mines, 64%.

Figure 2
Canadian Reserves of Selected Major Metals, 1981-99
Metal Contained in Proven and Probable Mineable Ore in Operating Mines and Deposits Committed to Production, as at December 31 of Each Year



Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
Note: This series was revised during 1996.

Current mine reserves of nickel in Canada are contained 99% in the SIC class of nickel-copper mines and 1% in the SIC class of miscellaneous metal mines.

Current mine reserves of lead in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 5%; and zinc-lead-silver mines, 95%.

Current mine reserves of zinc in Canada are contained in the SIC classes as follows: gold mines, 13%; copper and copper-zinc mines, 45%; and zinc-lead-silver mines, 42%.

Apparent Life of Canadian Reserves

The apparent life (life index) of mine reserves is usually calculated by dividing the total amount of metals remaining in mine reserves at the end of a given year by the corresponding amount of metals contained in the ores produced during that year. Similar calculations are often applied at the national level.

At the national level, life indices are but a very rough measure of the expected life of aggregate mine reserves and they are often misleading unless abnormal situations are recognized. Life indices based on proven and probable reserves do not make allowances for inferred extensions to reserves at current mines, gross additions that will accrue to current reserves from the likely development, in the foreseeable future, of known orebodies for which a production decision has yet to be made, or expected changes in production rates. Furthermore, life indices tend to overstate the apparent life of reserves when, for example, annual production is abnormally low due to strikes, cutbacks or suspensions at large establishments, or when significant increases in capacity resulting from new production decisions will be coming on stream, but only several years hence.

The apparent life indices for the major metals in Canada at the end of 1999 were 22 years for nickel, 11 years for copper, 11 years for silver, 9 years for zinc, 9 years for molybdenum, 8 years for gold and 8 years for lead.

Reserve Trends

Figure 2 and Table 6 show how Canadian reserves of copper, nickel, lead, zinc, molybdenum and silver have declined steadily since the early 1980s. In contrast, gold reserves increased substantially until 1988 before starting a gradual decline. At the end of 1999, Canadian reserves of copper, lead, zinc and molybdenum were lower than at any time since Natural Resources Canada began keeping records (1977), and reserves of nickel, silver and gold were only slightly higher than the recent historic lows that occurred in 1993 and 1994.

The annual aggregate change in Canadian reserves is the net result of three main factors affecting individual mines (Figure 3): additions to reserves, deletions to reserves, and production. Additions to reserves are the result of new discoveries; of new geological, metallurgical, production or other information; of a decrease in production costs; or of a rise in commodity prices, all of which increase the quantity of mineral resources that are profitable to mine. Deletions to reserves are the result of new geological, metallurgical, production or other information; of increases in costs; or of decreases in commodity prices, all of which reduce the quantity of mineral resources previously counted in mine reserves that are now expected to be mined at a profit. Production is normally the main factor reducing the reserves at individual mines but, in 1999, declining metal prices were a significant factor in the reduction of ore reserves at producing mines.

RECENT PRODUCTION DECISIONS

Several criteria need to be met for a project to be considered here to have reached the production decision stage. In general, there needs to have been a positive production feasibility study, all of the necessary permits must have been obtained, financing must have been arranged, and directors must have approved construction.

During 1999, Hudson Bay Mining and Smelting Co., Limited announced plans to bring the 777 deposit at Flin Flon, Manitoba, and the Chisel North deposit at Snow Lake, Manitoba, into production. The 777 deposit has reserves of 13.4 Mt containing 3.32% copper, 5.78% zinc, 2.7 g/t gold and 38 g/t silver. The Chisel North deposit has reserves of 2.4 Mt containing 10.8% zinc. Also during 1999, St. Andrew Goldfields Ltd. announced plans to begin production from a small open-pit mine on the Hislop West zone near Matheson, Ontario.

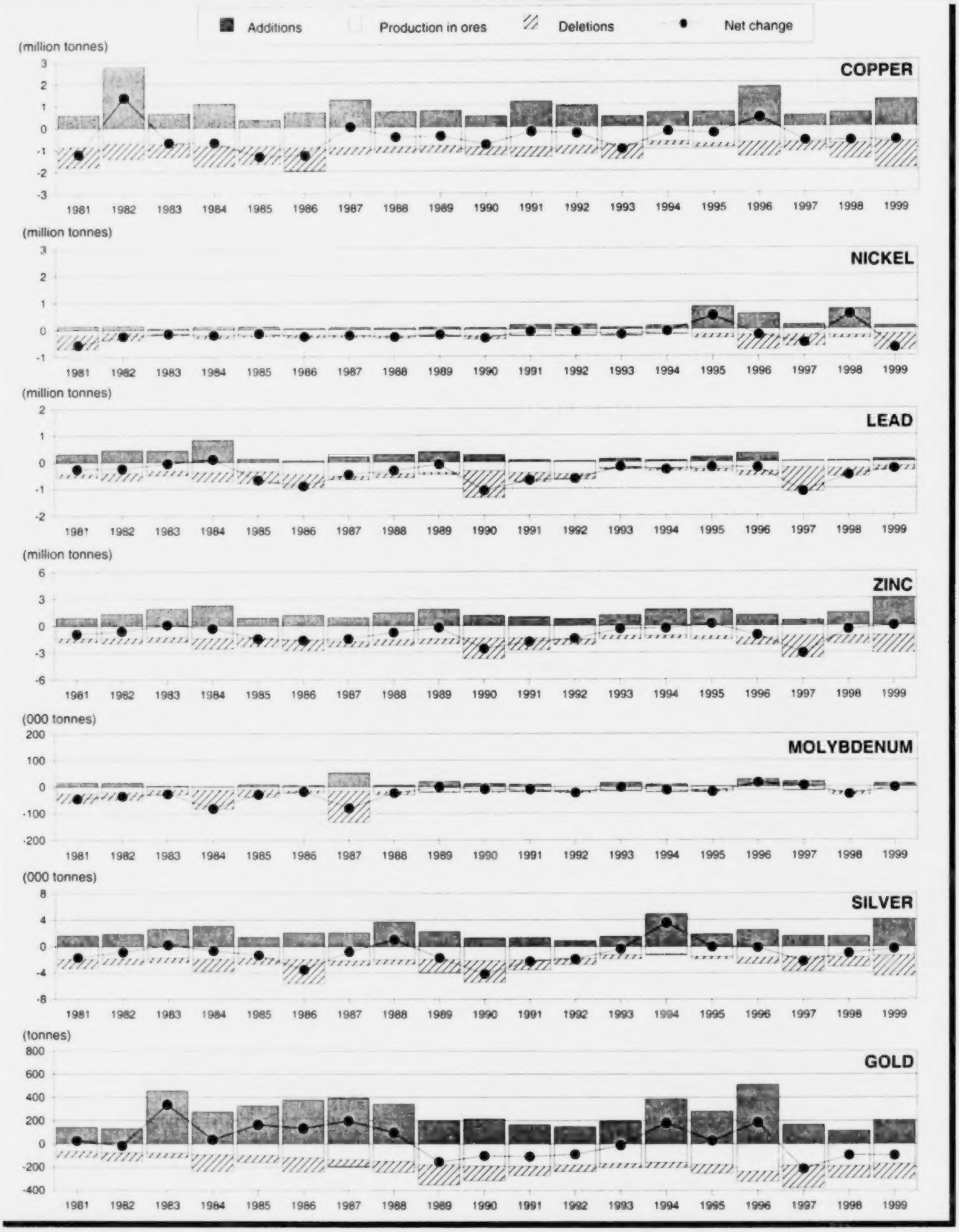
During 2000, there were no new production decisions.

Inco Limited's Voisey's Bay deposit in Labrador is poised for a production decision, but it is not included as a 2000 production decision because not all of the necessary permits and agreements were in place at that time.

OUTLOOK

Given that there were no new production decisions, and prices of most of the metals covered in this chapter were depressed during 2000, it is probable that mine reserves of precious metals and base metals will decline further during 2000.

Figure 3
Main Components of Change in Canadian Reserves of Selected Major Metals, 1981-99



Source: Natural Resources Canada.

At the Voisey's Bay nickel-copper-cobalt deposit, Inco had established proven reserves of 32 Mt grading 2.83% nickel, 1.68% copper and 0.12% cobalt at the end of 1999. If these figures are confirmed, Voisey's Bay will increase Canada's nickel reserves by about 18% and its copper reserves by about 7%.

Notes: (1) Information in this review was current as of February 11, 2001. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. MAIN COMPONENTS OF CHANGE DURING 1999 IN CANADIAN RESERVES OF SELECTED MAJOR METALS

Metal	Units	Revised Opening Metal Balance, January 1999	Metal in Ore Mined During 1999	Metal Apparently Written Off During 1999	Metal in New Reserves Found During 1999	Net Change During 1999	Closing Metal Balance, December 1999	% Change During 1999
Copper	000 t	8 402	–704	–1164	1 222	–594	7 763	–7
Nickel	000 t	5 683	–225	–565	91	–699	4 983	–12
Lead	000 t	1 845	1 586	–154	94	–261	1 586	–14
Zinc	000 t	10 159	10 210	–1 944	3 038	50	10 210	0
Molybdenum	000 t	121	–13	–	11	–2	119	–2
Silver	t	15 738	1 424	–3033	4 075	–355	15 368	–2
Gold	t	1 415	–172	–127	202	–97	1 326	–7

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
Note: May not balance due to rounding.
– Nil.

TABLE 2. TONNAGES AND GRADES OF OPERATIONS INCLUDED IN CANADIAN RESERVES OF SELECTED MAJOR METALS, AS AT JANUARY 1, 2000

Tonnages classified by companies as "possible" are not included where they are reported separately from proven and probable tonnages, nor are tonnages for deposits for which there is no firm production decision. Data reported in imperial units were converted to metric units and rounded to the corresponding number of significant digits. Confidential data have been suppressed from the details of this report.

		Grade						
	Tonnes	Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
NEWFOUNDLAND								
Nugget Pond								
Richmont Mines Inc.								
Proven and probable	249 476							10.97
NEW BRUNSWICK								
Brunswick No. 12 Underground								
Noranda Inc.								
Proven	33 226 000	0.39		3.39	8.64		103.30	..
Probable	4 200 000	0.27		3.48	8.60		94.90	..
QUEBEC								
Beaufor								
Aurizon Mines Ltd.								
Louvem Mines Inc.								
Proven	314 387						..	7.32
Probable	732 020						..	7.64
Bell Allard								
Noranda Inc.								
Proven	2 770 000	1.21		0.12	13.16		36.70	0.70
Probable	576 000	1.54		0.13	12.77		47.30	0.70
Bouchard-Hébert								
Cambior inc.								
Proven and probable	5 274 000	0.70			4.70		38.00	1.20
Bousquet No. 2								
Barrick Gold Corporation								
Mineable	2 540 117	0.29					..	6.31
Doyon								
Barrick Gold Corporation								
Cambior inc.								
Proven and probable	10 600 000						..	6.30
Francoeur								
Richmont Mines Inc.								
Proven and probable	398 254						..	7.54
Gallen								
Noranda Metallurgy Inc.								
Probable	465 000	0.16			4.58		29.90	1.00
Joe Mann								
Campbell Resources Inc.								
Proven	163 224	..					..	9.22
Probable	110 627	..					..	10.11
Kiena								
McWatters Mining Inc.								
Proven	1 724 000						..	4.08
Probable	926 000						..	4.20
Langlois (Grevet)								
Cambior inc.								
Proven and probable	5 610 000	0.60			9.40		43.00	0.10
LaRonde								
Agnico-Eagle Mines Limited								
Proven and probable	28 618 050	0.33			4.78		79.89	3.43
Louvicourt								
Aur Resources Inc.								
Novicourt Inc.								
Teck Corporation								
Proven	5 288 000	3.66			1.67		28.30	0.90
Probable	2 185 000	2.52			1.99		27.30	0.80
Raglan								
Falconbridge Limited								
Proven	7 407 000	0.78	2.97					
Probable	12 291 000	0.76	2.73					

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
QUEBEC (cont'd)								
Selbaie A1 Open Pit								
Billiton Metals Canada Inc. (Gencor Ltd.)								
Proven and probable	13 775 000	0.37		..	1.35		25	0.32
Sigma No. 1								
McWatters Mining Inc.								
Proven and probable	16 263 000						..	3.02
Sleeping Giant								
Aurizon Mines Ltd.								
Cambior inc.								
Proven	232 000						..	12.00
Probable	385 000						..	10.00
Troilus (Lac Frotet)								
INMET Mining Corporation								
Proven and probable	38 299 000	0.09					..	0.96
ONTARIO								
Campbell								
Placer Dome North America								
Proven and probable	4 044 000						..	14.50
David Bell								
Homestake Canada Inc.								
Teck Corporation								
Reserves	3 900 000						..	11.00
Dome (including Paymaster)								
Placer Dome North America								
Proven and probable	29 974 000						..	1.80
Eagle River								
River Gold Mines Ltd.								
Proven and probable	1 500 000						..	10.78
Edwards								
River Gold Mines Ltd.								
VenCan Gold Corporation								
Proven	85 900						..	12.10
Probable	90 600						..	14.46
Falconbridge Sudbury Integrated Nickel Operations								
Falconbridge Limited								
Proven	10 403 000	1.31	1.60					
Probable	9 099 000	1.39	1.44					
Glimmer								
Exall Resources Limited								
Glimmer Resources Inc.								
Mineable	1 137 000							8.31
Golden Giant								
Battle Mountain Gold Company								
Reserves	5 585 537						..	9.63
Holloway								
Battle Mountain Gold Company								
Teddy Bear Valley Mines, Limited								
Reserves	4 329 086						..	6.51
Holt-McDermott								
Barrick Gold Corporation								
Proven and probable	2 177 244						0.34	6.99
Hoyle Pond								
Kinross Gold Corporation								
Proven and probable	2 879 000						..	4.69
Inco Ontario Division								
Inco Limited								
Proven	157 000 000	1.16	1.26				..	..
Probable	71 000 000	1.37	1.53				..	0.19
Kidd Creek								
Falconbridge Limited								
Proven	19 213 000	2.29		..	5.57		66.00	
Probable	10 311 000	2.26		..	6.94		54.00	

TABLE 2 (cont'd)

		Grade						
	Tonnes	Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
ONTARIO (cont'd)								
Lac des Îles (palladium-platinum)								
North American Palladium Ltd.								
Proven	10 525 000	0.07	0.06					0.14
Probable	62 683 000	0.06	0.05					0.14
Musselwhite								
Placer Dome Inc.								
TVX Gold Inc.								
Proven and probable	13 838 235							5.80
Red Lake (Arthur W. White)								
Goldcorp Inc.								
Proven and probable	2 985 545						..	30.17
Williams								
Homestake Canada Inc.								
Teck Corporation								
Reserves	25 400 000						..	5.00
MANITOBA								
777								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	9 400 000	2.80			4.40		..	..
Bissett (San Antonio)								
Harmony Gold Mining Company Limited								
Mineable	2 100 000							6.67
Callinan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	3 100 000	1.30			5.00		..	2.00
Inco Manitoba Division								
Inco Limited								
Proven	24 000 000	0.16	2.39				..	..
Probable	21 000 000	0.13	2.15				..	..
Keystone								
Black Hawk Mining Inc.								
Stockpiles	126 500						..	2.24
New Britannia (Nor Acme/Snow Lake)								
High River Gold Mines Ltd.								
TVX Gold Inc.								
Reserves	2 843 000						..	6.72
Ruttan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	8 200 000	1.00			1.60		..	..
Trout Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	4 100 000	1.40			4.70		..	..
SASKATCHEWAN								
Konuto Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	900 000	4.30			1.40		..	..
Seabee								
Claude Resources Inc.								
Proven and probable	507 206						0.30	8.89
BRITISH COLUMBIA								
Endako								
Nissho Iwai Corporation								
Thompson Creek Mining Limited								
Mineable	..					..		
Eskay Creek								
Prime Resources Group Inc.								
Reserves	1 460 567						2 341.71	51.29

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
BRITISH COLUMBIA (cont'd)								
Golden Bear								
North American Metals Corp.								
Proven	494 416							..
Highland Valley								
Cominco Ltd.								
Highmont Mining Company								
Rio Algom Limited								
Teck Corporation								
Proven and probable	387 000 000	0.42				0.01	..	..
Huckleberry								
Mitsubishi Corporation, Dowa Mining Co., Ltd., Furukawa Co. Ltd., Marubeni Corporation								
Imperial Metals Corporation								
Proven and probable	61 762 000	0.50				0.01	2.76	0.06
Kemess South								
Royal Oak Mines Inc.								
Proven and probable	165 000 000	0.23						0.66
Mount Polley								
Imperial Metals Corporation								
Sumitomo Corporation								
Proven and probable	..	..						..
Myra Falls								
Westmin Resources Limited								
Proven	6 056 000	1.50			8.00		39.00	1.40
Probable	1 664 000	1.10			4.60		37.00	1.50
Sullivan								
Cominco Ltd.								
Proven	4 600 000			3.30	6.40		18.00	
YUKON TERRITORY								
Brewery Creek (Heap Leach)								
Viceroy Resource Corporation								
Reserves	3 053 000						..	1.59
NORTHWEST TERRITORIES								
Con								
Miramar Mining Corporation								
Proven	312 706						..	11.66
Probable	797 450						..	11.66
Giant Open Pit-Giant Underground								
Miramar Mining Corporation								
Proven and probable	207 518						1.37	12.41
NUNAVUT								
Lupin								
Echo Bay Mines Ltd.								
Proven	1 319 954						..	9.43
Probable	431 820						..	8.54
Nanisivik								
Nanisivik Mines Ltd.								
Proven and probable	3 222 000			0.40	7.40		31.00	
Polaris								
Cominco Ltd.								
Pine Point Mines Limited								
Reserves	2 100 000			3.50	13.20			

Source: Natural Resources Canada, based on published company reports.
. . Not available in published reports or estimated by author.
Notes: One tonne (t) = 1.1023113 short tons. One gram per tonne (g/t) = 0.02916668 troy ounces per short ton.

TABLE 3. PRODUCTION DECISIONS ADDED TO CANADIAN RESERVE TOTALS AS AT DECEMBER 31, 1999

Project	Operators and Major Partners	Province	Metals
777	Hudson Bay Mining and Smelting Co., Limited	Manitoba	Copper, zinc, silver, gold
Chisel North	Hudson Bay Mining and Smelting Co., Limited	Manitoba	Zinc

Source: Natural Resources Canada, based on company reports.

TABLE 4. CANADIAN RESERVES OF SELECTED MAJOR METALS BY PROVINCE AND TERRITORY, AS AT DECEMBER 31, 1999

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

Metal	Units[3]	Nfld.	N.B.	Que.	Ont.	Man.	Sask.	B.C.	Yukon	N.W.T.	Nunavut	Canada[5]
Copper	000 t	–	141	704	3 777	509	39	2 594	–	–	–	7 763
Nickel	000 t	–	–	556	3 402	1 025	–	–	–	–	–	4 983
Lead	000 t	–	1 273	13	62	–	–	152	–	–	86	1 586
Zinc	000 t	–	3 232	2 916	1 786	893	13	855	–	–	516	10 210
Molybdenum	000 t	–	–	–	–	–	–	119	–	–	–	119
Silver	t	–	3 831	3 622	2 861	579	9	4 358	2	3	102	15 368
Gold[4]	t	3	26	318	639	72	7	225	5	16	16	1 326

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
– Nil or less than one unit.
[1] No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. [2] Includes metal in mines where production has been suspended temporarily. [3] One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. [4] Excludes metal in placer deposits because reserves data are generally unavailable. [5] May not balance due to rounding at the provincial level.

TABLE 5. CANADIAN RESERVES OF SELECTED MAJOR METALS BY INDUSTRY, AS AT DECEMBER 31, 1999

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

		Gold Mines	Copper, Copper-Zinc Mines	Nickel-Copper Mines	Zinc-Lead-Silver Mines	Molybdenum Mines	Miscellaneous Metal Mines	
	SIC no.[5]	0611	0612	0613	0614	0615	0619	Canada[6]
	(Units[3])							
Copper	000 t	138	4 126	3 274	178	–	48	7 761
Nickel	000 t	–	–	4 943	–	–	40	4 983
Lead	000 t	–	75	–	1 511	–	–	1 586
Zinc	000 t	1 368	4 552	–	4 290	–	–	10 210
Molybdenum	000 t	–	43	–	–	75	–	119
Silver	t	5 947	4 206	1 001	4 214	–	–	15 368
Gold[4]	t	1 045	199	39	32	–	10	1 326

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
– Nil or less than one unit.
[1] No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. [2] Includes metal in mines where production has been suspended temporarily. [3] One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. [4] Excludes metal in placer deposits because reserves data are generally unavailable. [5] SIC Standard Industrial Classification. [6] May not balance due to rounding at the SIC level.

TABLE 6. CANADIAN RESERVES OF SELECTED MAJOR METALS AS AT DECEMBER 31 OF EACH YEAR, 1977-99

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

Year	Copper	Nickel	Lead	Zinc	Molybdenum	Silver	Gold[3]
	(000 t)	(000 t)	(000 t)	(000 t)	(000 t)	(t)	(t)
1977	16 914	7 749	8 954	26 953	369	30 991	493
1978	16 184	7 843	8 930	26 721	464	30 995	505
1979	16 721	7 947	8 992	26 581	549	32 124	575
1980	16 714	8 348	9 637	27 742	551	33 804	826
1981	15 511	7 781	9 380	26 833	505	32 092	851
1982	16 889	7 546	9 139	26 216	469	31 204	833
1983	16 214	7 393	9 081	26 313	442	31 425	1 172
1984	15 530	7 191	9 180	26 000	361	30 757	1 208
1985	14 201	7 041	8 503	24 553	331	29 442	1 373
1986	12 918	6 780	7 599	22 936	312	25 914	1 507
1987	12 927	6 562	7 129	21 471	231	25 103	1 705
1988	12 485	6 286	6 811	20 710	208	26 122	1 801
1989	12 082	6 092	6 717	20 479	207	24 393	1 645
1990	11 261	5 776	5 643	17 847	198	20 102	1 542
1991	11 040	5 691	4 957	16 038	186	17 859	1 433
1992	10 755	5 605	4 328	14 584	163	15 974	1 345
1993	9 740	5 409	4 149	14 206	161	15 576	1 333
1994	9 533	5 334	3 861	14 514	148	19 146	1 513
1995	9 250	5 832	3 660	14 712	129	19 073	1 540
1996	9 667	5 623	3 450	13 660	144	18 911	1 724
1997	9 032	5 122	2 344	10 588	149	16 697	1 510
1998	8 402	5 683	1 845	10 159	121	15 738	1 415
1999	7 761	4 983	1 586	10 210	119	15 368	1 326

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

[1] No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. [2] Includes metal in mines where production has been suspended temporarily. [3] Excludes metal in placer deposits because reserves data are generally unavailable.

Note: One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces.

Mineral Exploration, Deposit Appraisal and Mine Complex Development Activity in Canada

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INTRODUCTION

This review provides analytical highlights and describes mineral development activities from primary exploration to mine production in Canada during 1999 with emphasis on mineral exploration and deposit appraisal expenditures. Also briefly presented are preliminary estimates for total expenditures in 2000 and company spending intentions for 2001, as well as other exploration indicators such as drilling and claim-staking activity.

Total mineral development investment in Canada on the three work phases – mineral exploration, deposit appraisal, and mine complex development (including capital, and repair and maintenance expenditures) – fell by 23.0% from $4.6 billion in 1998 to $3.5 billion in 1999 (Tables 1 and 2a). Mineral development expenditures (excluding expenditures for capital and repair and maintenance) amounted to $1.4 billion in 1999, a decrease of 16.2% from $1.6 billion in 1998. Expenditures on the combined exploration and deposit appraisal work phases totaled $504.3 million in 1999, a decrease of 23.1%, or $151.6 million, from 1998. Some 62.4% of the 1999 spending, or $314.7 million, was for the exploration work phase, of which $270.2 million was for off-mine-site activity.

The 1999 decline in exploration and deposit appraisal expenditures reflects the slump in metal prices that began in 1996 and 1997. The average annual prices of gold, nickel, zinc, copper and lead were all lower in 1998 than in the previous two years, and this trend continued into 1999, except for nickel. Particularly important for Canada's exploration industry is the gold price. From an annual average of US$388/oz in 1996, the price declined to US$328/oz in 1997, US$294/oz in 1998 and US$278/oz in 1999, and then rose slightly to US$279/oz in 2000. The weak commodity prices made marginal mines uneconomic, leading to 24 mine closures. Although 10 new mines came on stream in 1999, the number of closures continued to exceed that of openings for the second consecutive year. Corporate mergers and changes in corporate strategy may also have influenced the sharp reduction in exploration spending in 1999. At about the same time, the high-tech sector started to catch fire, thereby contributing to the reduction in investment and risk capital available to the mining industry. Another important factor is company commitments to exploration and development activities in other countries. But this downward trend in Canadian exploration activity is also mirrored in other mining countries. Despite a deteriorating situation, Canada remains second in the world as a recipient of exploration expenditures, and exploration activity is expected to more or less stabilize in 2000 and 2001 once the final results are confirmed.

Expenditures are compiled from the federal-provincial-territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures, which is described in the Background section of this chapter. This annual survey of exploration and mining companies provides an accurate measure of mineral development activity in Canada. In 1999, survey results were compiled from the reports of 595 active company project operators and from some prospectors. Of these companies, 500 reported that they were active in exploration, 95 in deposit appraisal and 121 in mine complex development. (Note: Some companies may be involved in more than one work phase at the same time.) Detailed 1998 statistics for comparison purposes can be found in the 1999 edition of the *Canadian Minerals Yearbook*.

MINERAL DEVELOPMENT EXPENDITURES, 1999

The wide spectrum of mineral development activities and their geographic dispersion across Canada require detailed and sophisticated indicators to measure activity levels. The information collected since 1997 by mineral development work phase permits a more complete monitoring of the activities of an exploration project as it progresses toward the mine complex development stage (Table 16).

Mineral Exploration

Of the $1.4 billion in mineral development expenditures in 1999, the mineral exploration phase (which includes activities up to and including the first delineation of a previously unknown mineral deposit to establish its potential economic value [tonnage and grade]) accounted for $314.7 million (23.2%) in 1999 compared to $462.8 million (28.5%) in 1998 (Table 1). The exploration total for 1999 represents 62.4% of all exploration and deposit appraisal expenditures compared to 70.6% in 1998. In 1999, some 85.9% of spending in the mineral exploration phase was at off-mine-site locations, up slightly from 85.3% in 1998. Junior companies spent $92.7 million in 1999 on exploration at off-mine-site locations while seniors spent $177.5 million.

Off-mine-site exploration accounted for 82.4% ($124.9 million) of the total decrease of $151.6 million in exploration and deposit appraisal expenditures between 1998 and 1999. Junior companies accounted for 42% of the decrease while seniors accounted for 58%. Since the decrease in off-mine-site exploration expenditures was more significant, it had an impact on overall exploration and deposit appraisal expenditures and explains the decline in the exploration share of total expenditures (62.4%, compared to 70.6% in 1998).

In 1999, Quebec ranked first, followed by Ontario, in the receipt of exploration expenditures. These two provinces accounted for close to half of the total exploration expenditures (Tables 7, 9a and 9b). In 1998, this ranking was reversed. In 1999, exploration expenditures exceeded deposit appraisal expenditures in all provinces and territories except Saskatchewan (uranium) and the Northwest Territories (diamonds) where deposit appraisal was the main focus of expenditures (Figures 6a and 6b). Off-mine-site exploration was dominant over on-mine-site exploration in all provinces and territories. For off-mine-site exploration expenditures, Quebec was by far the leader while Ontario was well ahead of other jurisdictions for on-mine-site exploration expenditures, the same as in 1998.

In decreasing order of exploration expenditures by commodity group, precious metals rank first, followed closely by base metals and then diamonds (Table 13a). They accounted for $114.6 million, $110.5 million and $51.9 million, respectively. The ranking of commodities sought for off-mine-site exploration was base metals first, followed by precious metals and then diamonds; for on-mine-site exploration, precious metals led followed by base metals. Looking at the dominant commodity groups in the provinces and territories, it is noteworthy that precious-metal exploration was dominant in Ontario, Quebec, British Columbia and the Yukon; base metals were dominant in Manitoba, Newfoundland and New Brunswick; uranium, in Saskatchewan; diamonds, in the Northwest Territories, Nunavut and Alberta; and nonmetals, in Nova Scotia (Figure 6a).

Deposit Appraisal

For the deposit appraisal phase, which includes activities that bring a delineated deposit to the stage of detailed knowledge required for a production feasibility study, expenditures in 1999 totaled $189.7 million (14.0%), down from $193.1 million (11.9%) spent in 1998 (Table 1). The percentage of deposit appraisal expenditures spent on off-mine-site locations was 77.7% in 1999 and 68.1% in 1998. At off-mine-site locations, junior companies spent $48.5 million on deposit appraisal activities in 1999 while seniors spent $98.9 million.

In 1999, the Northwest Territories ranked first followed by Quebec and Saskatchewan in terms of deposit appraisal expenditures (Tables 7, 9a and 9b). They accounted for about 60% of the total deposit appraisal expenditures. Deposit appraisal at off-mine-site locations was dominant everywhere except in Quebec, Manitoba and New Brunswick where deposit appraisal at on-mine-site locations ranked first, attributable to precious metals for Quebec and base metals for the latter two. For deposit appraisal expenditures at off-mine-site properties, the Northwest Territories was first (well ahead) while Quebec ranked first for deposit appraisal at on-mine-site properties.

In decreasing order of deposit appraisal expenditures by commodity group, precious metals were closely followed by diamonds and then base metals (Table 13b). Respectively, they accounted for $66.4 million, $56.8 million and $28.9 million of the $189.7 million. When considering deposit appraisal at off-mine-site locations, the commodity trend is first, diamonds; second, precious metals; and third, uranium. For deposit appraisal at on-mine-site locations, precious metals and base metals are the dominant commodity groups.

Linking total deposit appraisal expenditures to the dominant commodity group in the provinces and territories, the distribution is the same as for exploration except for Alberta and Nunavut where, respectively, coal and precious metals lead instead of diamonds.

Mine Complex Development

Expenditures on the mine complex development phase, which includes activities to define, block out and gain access to the ore, prepare it for production, and other field work to extend the current ore reserves, decreased to $854.2 million in 1999 from

$966.1 million in 1998, a decline of 11.6% (Table 1). By definition, all activities in the mine complex development phase are on-mine-site activities. At times, "mine development expenditures" is used to represent spending excluding capital and repair costs.

In 1999, as in 1998, Quebec was first, followed by Ontario, and together they represented 68.6% of all mine complex development expenditures (Table 9d), while Saskatchewan ranked third. Precious metals, the main commodity group sought, represented 32.4% of all expenditures for this work phase (Table 13d).

Mineral Development Activity by Work Phase, 1999

The distribution pattern of the different activities reflects project evolution over time. Figure 4 shows graphically and quantitatively how the distribution of expenditures in the exploration work phase is different from those in the deposit appraisal work phase and the mine complex development phase.

In 1999, **exploration** work phase expenses included: drilling, 45.0% (87.5% surface drilling); geoscientific surveys, 34.5% (50% geology, followed by ground geophysics); rock work (including stripping), 4.1%; overhead and other costs, 13.0%; engineering, economic and feasibility studies, 2.0% (mainly engineering studies); environment, 0.9%; and land access, 0.5% (Table 9a).

The breakdown for **deposit appraisal** work phase expenditures was: drilling, 31.1% (66% surface drilling); geoscientific surveys, 5.1% (72% geology); rock work (including stripping), 23.8% (mainly rock work); overhead and other costs, 10.6%; engineering, economic and feasibility studies, 18.2% (mainly engineering studies); environment, 8.3%; and land access, 2.9% (Table 9b).

The distribution of expenditures in the **mine complex development** work phase was even more distinctive with expenditures of: drilling, 9.3% (58% underground drilling); geoscientific surveys, 1.5% (mainly geology); rock work (including stripping), 71.8%; overhead and other costs, 10.7%; engineering, economic and feasibility studies, 2.9% (mainly engineering studies); environment, 3.7%; and land access, 0.2% (Table 9d).

In summary, the exploration work phase is characterized mainly by surface drilling and geoscientific surveys that are used to discover a deposit and complete its first delineation. In the deposit appraisal work phase, the deposit is better defined by further surface and underground drilling and, in many cases, the beginning of important rock work. Ultimately, intense engineering studies are conducted and a feasibility study concludes this phase. If the feasibility study results are positive, a commitment to go into production is usually made. The mine complex development phase is characterized by large-scale underground rock work and capital investment in order to build or extend the mine and its facilities.

TOTAL MINERAL DEVELOPMENT INVESTMENT, 1999

Total mineral development investment in Canada, including capital and repair and maintenance expenditures, fell by 23.0% from $4.6 billion in 1998 to $3.5 billion in 1999 (Tables 1 and 2a). Capital, and repair and maintenance expenditures include spending for construction, machinery and equipment. Most of these expenditures (97.4%) were directed at mine complex development in 1999. For that year, $875 million was spent on capital investment while $1.3 billion was spent on repair and maintenance. The former represents about one quarter and the latter represents about one third of the total mineral development investment. Compared to 1998, capital investment decreased 30.7% and repair and maintenance costs decreased 23.8%.

As shown in Figure 1, Quebec, Ontario, Saskatchewan and British Columbia represented 76.2% of all mineral development investment. The highest level of capital investment was recorded in Saskatchewan (26.6%) and, together with Quebec and Ontario, they represented 69.1% of all capital expenditures. In Nova Scotia, spending on capital expenditures exceeded those of other mineral development expenditures in the province and are the result of sustained investment in industrial minerals mines. Furthermore, Nova Scotia ranked fifth as a recipient of capital investment. The smallest contribution of capital investment compared to the other mineral development investment for a single province or territory was recorded in Nunavut. Saskatchewan, Quebec and British Columbia received the biggest share of capital investment in 1998, and Saskatchewan was first in terms of capital investment received compared to other mineral development investment made in the province.

In 1999, investment in the environment (included in the above total investment) accounted for 3.2% ($111.3 million) of all investment (Table 2b).

HISTORICAL AND FUTURE PERSPECTIVE

Figure 2 shows the historical trend in exploration and deposit appraisal expenditures, mainly for field and overhead activities, adjusted to constant 2000 dollars (see also Tables 3a and 3b). After unprecedented peak levels of exploration and deposit appraisal expenditures were reached in 1987 and 1988 (principally as a result of the Canadian Mining Exploration Depletion Allowance [MEDA]), activity fell to a low of $434 million in 1992 (in constant 2000 dollars). From 1993 to 1996, higher metal prices and significant diamond and nickel-copper discoveries in the Northwest Territories (Lac de Gras) and Labrador (Voisey's Bay), respectively, caused the level of activity to rebound to $945 million in 1996 and $858 million in 1997. Subsequently, the Bre-X stock incident, the Asian financial and economic crisis, and lower metal prices afterward contributed to the beginning of a decline in expenditures. Most recent indications are that expenditures will likely continue to decrease again in 2000 and 2001, albeit at a much slower pace than what was first recorded under the Preliminary Estimate 2001 and Forecast 2000 Survey. The impact of the various federal and provincial tax credit measures recently put in place has not yet been determined and, at the time of writing, it was too early to speculate on the effects of the September 11 terrorist attack on the demand and supply of metals.

PRELIMINARY ESTIMATES, 2000, AND SPENDING INTENTIONS, 2001

Preliminary estimates for 2000 show a further decline in mineral development expenditures to $1.2 billion from $1.4 billion in 1999 and, for 2001, company spending intentions are expected to remain at about $1.2 billion (Table 2c).

Of these totals, mineral exploration and deposit appraisal expenditures are estimated at $473 million for 2000 while company spending intentions for 2001 are estimated at $458 million. The 2001 intentions are subject to change because some major companies had difficulty forecasting at the time of the survey. These estimates continue the downward trend in expenditures that followed the peak year of 1996 and are hopefully reaching the bottom of the slope. The situation could also be helped by the junior sector expenditures, which should increase to $149 million and $167 million, respectively, for 2000 and 2001, compared with $141 million in 1999.

For total mineral development investment, the trend is the opposite with an estimate of $3.6 billion for 2000, up from $3.5 billion in 1999. Company spending intentions for 2001 are expected to reach $3.8 billion. Larger capital investment for those two years more than offset the decreases recorded in the non-capital expenditures. In fact, the construction of a second diamond mine in the Northwest Territories, the Diavik diamond project, scheduled to begin production in 2003, has resulted in the beginning of large capital investment from the time the decision was made to be committed to production during the year 2000. The total mineral investment for diamonds was estimated to reach $427.4 million in 2000 (Table 5).

MORE ABOUT MINERAL DEVELOPMENT ACTIVITIES

Traditional indicators of exploration activity also include new mineral claims acquired and the total number of metres drilled (Figure 3); however, expenditures on mineral exploration and deposit appraisal have proven to be the most accurate indicator of mineral exploration and deposit appraisal activity. Later we will review highlights of the sum of exploration and deposit appraisal work phase expenditures (formerly called exploration, at large, in pre-1997 survey years).

New Mineral Claims, 2000

New mineral claims staked or recorded in Canada in 2000 covered an area of 10.4 million hectares (ha), compared to 5.4 million ha in 1999. Alberta, Quebec and Manitoba accounted for about 60% of the total staking activity during the year (Tables 6a and 6b). For the fourth year in a row, Alberta was the leading province with over 2 million ha staked, accounting for nearly 23% of total new mineral claim activity. However, this was down significantly from the diamond claim staking that occurred in Alberta in recent years, most notably in 1997 when over 37 million ha were staked. Major increases were recorded in most provinces and territories, except for Nova Scotia, the Yukon and Nunavut. The area of new claims staked more than tripled in Saskatchewan and Manitoba as a result of a resurgent interest in diamond prospecting. Staking activity was concentrated, respectively, in the Fort à la Corne and Fox River Sill areas.

Drilling Activity for Exploration and Deposit Appraisal, 1999

Total exploration and deposit appraisal drilling (both diamond and other types) amounted to 2.5 million metres (m) in 1999 (Tables 9c and 10), down from 2.6 million m in 1998. Of the 1999 total, diamond drilling accounted for 92.3%, or 2.3 million m. Surface exploration and deposit appraisal drilling totaled 1.8 million m, 89.9% being diamond drilling. Underground exploration and deposit appraisal drilling amounted to 0.69 million m, 98.6% of this being diamond drilling. The statistics reveal that 31.2% of all metres drilled were for on-mine-site exploration and deposit appraisal.

In terms of regional activity in 1999, Quebec, Ontario, Alberta, Newfoundland and Saskatchewan, in decreasing order of importance, were the busiest jurisdictions, accounting for 78.5% of all drilling (surface and underground) (Table 9c).

Of the 1.8 million m drilled for surface exploration and deposit appraisal, 46.0% was undertaken for precious metals, 28.0% for base metals, 8.0% for coal, 7.5% for diamonds, and 3.5% for uranium. Quebec at 39.7%, Ontario at 13.8% and Alberta at 8.1% were the leading jurisdictions for surface drilling in Canada during 1999 (Table 11a).

Of the 692 000 m drilled for underground exploration and deposit appraisal, precious metals activity accounted for 72.3% and base metals for 25.0%. Ontario accounted for 58.4% of total underground activity followed by Quebec with 29.4% (Table 11b).

On-Mine-Site and Off-Mine-Site Exploration and Deposit Appraisal Expenditures, 1999

Exploration and deposit appraisal expenditures for off-mine-site activity were $417.6 million in 1999 while on-mine-site activity totaled $86.8 million (Table 1). These levels are down from 1998 when expenditures were $526.5 million for off-mine-site work and $129.4 million for on-mine-site work.

The Northwest Territories ranked first with 20.1%, followed by Quebec at 18.0% and Ontario at 13.1%, of the total off-mine-site exploration and deposit appraisal spending in 1999 (Table 7). In comparison, Quebec accounted for 44.4% while Ontario accounted for 37.8% of the total on-mine-site spending. There was no on-mine-site spending reported in the Northwest Territories and Nova Scotia.

Of the mineral commodities sought in 1999, precious metals accounted for 28.8% of off-mine-site expenditures followed by base metals at 27.7% and diamonds at 26.0%. On-mine-site expenditures on the search for precious metals amounted to 70.1% of the total, with base metals at 27.3% (Table 12). There were no on-mine-site expenditures for diamonds.

Exploration and Deposit Appraisal Activity by Province/Territory, 1999

Across the country, with the exception of New Brunswick, which maintained the status quo, activity levels in 1999 were down from 1998. Only Quebec had expenditures in excess of $100 million. The three leading jurisdictions in decreasing order of expenditures were Quebec, Ontario and the Northwest Territories, which accounted for 56.5% of Canada's total exploration and deposit appraisal expenditures during 1999. Significant declines (above 30%) in percentage terms occurred in Alberta, the Yukon and Newfoundland but, in dollar terms, the Northwest Territories and Nunavut together (they were not split in 1998), followed by Ontario and Saskatchewan, represented 52.8% ($80.0 million) of the total decrease of $151.6 million (Tables 8 and 9c).

Exploration and Deposit Appraisal Expenditures by Mineral Commodity Sought, 1999 and Previous Years

Precious metals (including gold, silver and platinum group elements [PGE]), base metals (including copper, nickel, lead and zinc), and diamonds continued to be the principal targets of exploration and deposit appraisal activities in Canada in 1999 (Tables 12 and 13c, Figure 5).

Precious metals exploration and deposit appraisal expenditures declined by 25.5% to $181.0 million in 1999, down from $243.0 million in 1998 (Table 12). This type of exploration represented only 35.9% of total Canadian expenditures in 1999, which is comparable to 37.0% in 1998. Despite this decline, precious metals expenditures exceeded those for base metals, as has generally been the case with the exception of 1992 and the period prior to 1985.

Quebec was the leading recipient of exploration and deposit appraisal expenditures for precious metals at 34.0% ($61.6 million) followed by Ontario at 29.2% ($52.8 million) (Table 13c). The other leading jurisdictions were British Columbia at 13.9% and Nunavut at 9.6%. For all of these jurisdictions and the Yukon, precious metals were the dominant commodity group searched for. It is also worth noting that PGE expenditures were at a record level with $21 million reported (most of it in Ontario). All jurisdictions were down from 1998 spending levels for precious metals, with the exception of Newfoundland, New Brunswick and Alberta (Figure 6c).

Base metals remained the second most sought-after commodity grouping in 1999. Base-metal exploration and deposit appraisal expenditures fell by 27.5% to $139.3 million in 1999 from $192.1 million in 1998 (Table 12). Prior to this, base-metal exploration and deposit appraisal had been buoyant, especially in 1996, and was mostly attributed to the overall impact of the late 1994 major nickel-copper discovery at Voisey's Bay in Labrador. Base-metal activities accounted for 27.6% of total Canadian exploration and deposit appraisal expenditures in 1999.

In 1999, Quebec was the leading recipient of base-metal exploration and deposit appraisal expenditures at 28.1% ($39.1 million) (Table 13c, Figure 6c). The other leading jurisdictions were Ontario at 17.4% ($24.2 million), Manitoba at 14.2% ($19.7 million), and Newfoundland at 13.0% ($18.1 million). For Newfoundland, New Brunswick and Manitoba, base metals were the main commodity group searched for.

The third most sought-after commodity was diamonds. Diamond exploration and deposit appraisal expenditures decreased slightly to $108.7 million in 1999 from $119.1 million in 1998 (Table 12). Progress continued towards a development decision during 2000 at the potential Diavik diamond mine in the Northwest Territories. Spending on diamonds accounted for 21.6% of all exploration and deposit appraisal expenditures in Canada during 1999. As in recent years, the largest amount of exploration and deposit appraisal spending on diamonds in Canada, $79.7 million, or 73.3%, occurred in the Northwest Territories (Table 13c, Figure 6c). This was followed by Nunavut with $11.0 million, and Alberta and Ontario, each with $7.8 million. Most of the other provinces and territories received some diamond exploration expenditures, except for Nova Scotia, New Brunswick, British Columbia and the Yukon. Diamonds were the leading commodity sought in the Northwest Territories and Alberta only, accounting for 94.7% and 53.0% of their respective total exploration and deposit appraisal spending.

All other mineral commodities accounted for $75.3 million of exploration and deposit appraisal expenditures in Canada during 1999, down from $101.7 million in 1998 and constituting about 15.0% of total Canadian exploration and deposit appraisal expenditures (Table 13c, Figure 6c). They consist of uranium at 46.7%, other metals at 20.6%, nonmetals at 15.9%, coal at 10.9%, and iron at 5.8%. Most of the uranium expenditures were reported in Saskatchewan (97.3%), where uranium is the leading commodity sought. The nonmetals category totaled $12.0 million, of which 42.9% of the expenditures were for salt, barite, fluorite and kaolin, about $1 million each and up to $2 million for kaolin. Nova Scotia, Quebec, British Columbia and Newfoundland represented 91.8% of all nonmetals expenditures, which remain the leading commodity group for Nova Scotia. Coal is primarily reported in Alberta and remained the second most sought-after commodity there for the second year in a row.

Exploration and Deposit Appraisal by Range of Expenditures and by Type of Company (Juniors and Seniors), 1999

Companies active in exploration and deposit appraisal in Canada are classified into six groups: (1) producers, (2) affiliates of producing mining companies, (3) oil companies, (4) foreign companies, (5) junior companies and prospectors, and (6) other companies. A company is classified into the first of these groups in which it fits. Seniors are covered by groups 1, 2, 3, 4 and 6.

Exploration and deposit appraisal spending by senior companies declined from $485.4 million in 1998 to $363.2 million in 1999, while the same spending by junior companies declined from $170.5 million in 1998 to $141.2 million in 1999 (Table 4). The share of total spending by juniors was about the same as in 1998 at around 28%.

Of the 532 active company project operators (excluding prospectors) in 1999, 72 (spending more than $1 million each) accounted for 82.7% of the total exploration and deposit appraisal expenditures of $504.3 million (Table 4). This compares to 91 operators accounting for 84.1% in 1998. In 1999, 48 of these were senior companies (57 in 1998) representing 68.5% ($345.3 million) of all Canadian expenditures, compared to 71.2% ($467.0 million) in 1998; 24 were junior companies (34 in 1998), representing 14.3% ($72.1 million), compared to 12.9% ($84.4 million) in 1998. About 50% of the junior expenditures occurred in the expenditure ranges above $1 million, compared to 95% for the seniors in the same expenditure ranges.

During 1999, there were fewer junior project operators in the expenditure ranges higher than $1 million than in 1998, leading to decreased spending in these categories. Two junior companies spent more than $10 million each in 1999, while much less was spent in the $1 million-$5 million and $5 million-$10 million ranges. The major decrease in number of junior project operators was for the $100 000-$200 000 range of expenditures, but it only had a very small impact on the overall junior spending (minus $4.7 million). The majority of junior project operators (163) spend in the $1-$50 000 range of expenditures but, in total, they contribute less than 2% of all junior spending.

For the seniors, most of the decrease in expenditures was a result of fewer companies spending more than $10 million (five less project operators for a decrease of $107.4 million). The majority of senior project operators spend in the $1 million-$5 million range of expenditures but represent only 17.4% of all senior expenditures. There is also a significant number of senior project operators in the $1-$50 000 range of expenditures (23) representing less than 1% of the senior expenditures.

Exploration and Deposit Appraisal Expenditures by Type of Company, 1999

Producing companies and their affiliates spent $295.0 million, or 58.5%, of total exploration and deposit appraisal expenditures in Canada in 1999. On a provincial and territorial basis, these producers and their affiliates were the largest spending group in all provinces and territories with the exception of Nova Scotia, British Columbia, Nunavut and the Yukon, where junior companies were the largest spending group (Table 15c, Figure 7c). In 1999, producing companies and their affiliates directed 36.7% ($108.4 million) of their $295.0 million of exploration and deposit appraisal expenditures at precious metals, 30.9% ($91.1 million) at base metals, 14.2% ($41.8 million) at diamonds, 10.7% ($31.7 million) at uranium, 2.7% ($7.9 million) at other metals, 2.6% ($7.5 million) at coal, and 2.2% ($6.4 million) at the total of iron and nonmetals (Table 14c, Figure 8c).

Of the $141.2 million spent by juniors, Quebec, British Columbia and the Northwest Territories together contributed 52.7%, or $74.5 million, with each spending between $20 million and $30 million. Juniors in 1999 directed 38.7% ($54.7 million) of exploration and deposit appraisal expenditures at precious metals, 28.2% ($39.8 million) at base metals and 19.4% ($27.4 million) at diamonds.

The foreign mining company group spent about the same amount as in 1998, $51.0 million, or 10.1% of the Canadian total. Of these expenditures, 81.0% was spent in the Northwest Territories, Nunavut and Ontario. Of their $51.0 million of exploration and deposit appraisal spending in 1999, foreign companies targeted 71.0% ($36.2 million) at diamonds, 20.6% ($10.5 million) at precious metals, and 8.1% ($4.1 million) at base metals.

Other companies (whose main income is from other business ventures, including producing mines outside of Canada) represent 3.2% ($16.1 million) of the total exploration plus deposit appraisal expenditures. They are mainly involved in Quebec (62.3%). In decreasing order of expenditures, 87.3% of all the spending was reported for precious metals, base metals and diamonds. The contribution from oil companies is still at a very low level, less than 1%, and expenditures are reported under precious metals, base metals and coal. We are far from the record level of 1977 when they accounted for nearly one quarter of all non-petroleum mineral exploration expenditures in Canada.

BACKGROUND INFORMATION ON MINERAL DEVELOPMENT STATISTICS

Natural Resources Canada (NRCan) coordinates the collection of all statistics for off-mine-site and on-mine-site expenditures for the exploration and deposit appraisal phases and the mine complex development phase. Statistics Canada coordinates the collection of detailed on-mine-site statistics on capital, repair and maintenance expenditures reported by producers at the mine complex development phase. NRCan and Statistics Canada cooperate with the provinces and territories to collect, assemble and publish the comprehensive national mineral development statistics presented in this review. These are compiled from the annual federal-provincial-territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures. To protect the confidential data provided by respondents, only aggregate statistics are released.

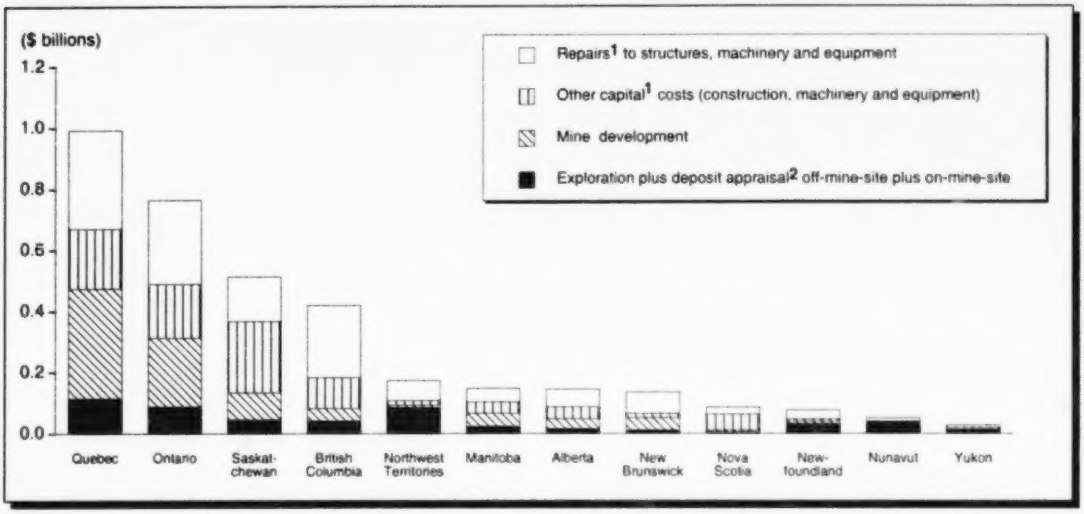
New definitions of work phases for mineral development were introduced in the 1997 survey. They provide a more complete and accurate coverage of mineral development expenditures in Canada from exploration to mine production. Table 16 describes the mineral development cycle upon which the new definitions are based. Specific definitions by category of expenditures are available on NRCan's exploration web site at http://www.nrcan.gc.ca/mms/efab/mmsd/exploration/default.html.

Notes: (1) Information in this review was current as of June 1, 2001. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

Note to Readers

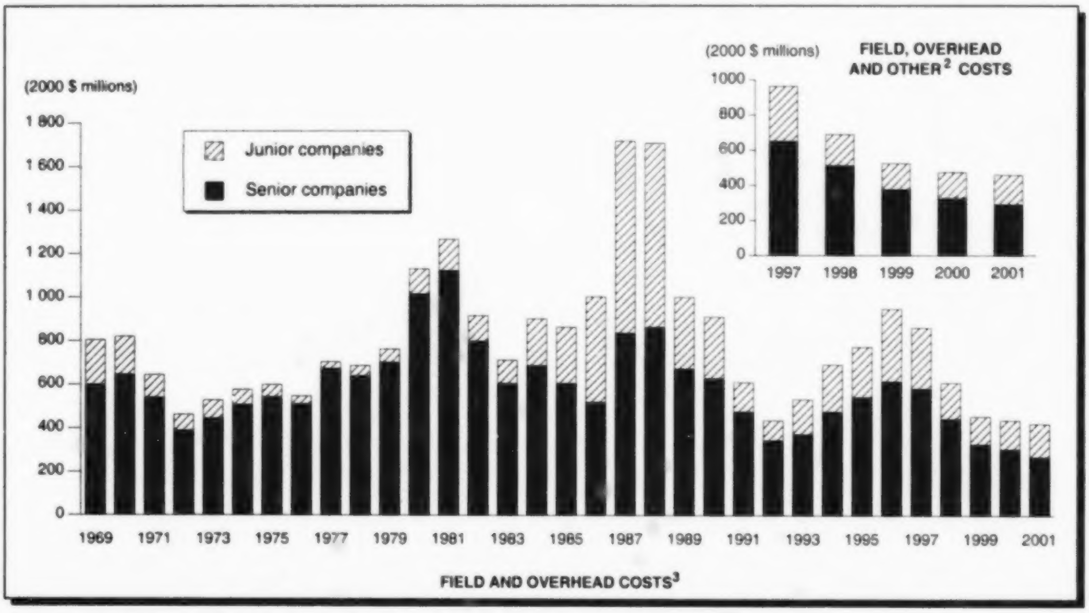
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 1
Total Mineral Development Investment in Canada, by Province and Territory, 1999
$3.5 Billion



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes expenditures related to exploration, deposit appraisal and mine complex development (97.4%). [2] Exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves.

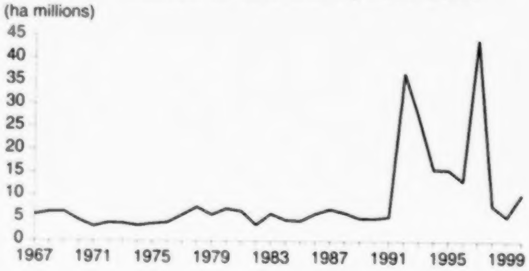
Figure 2
Exploration Plus Deposit Appraisal Expenditures,[1] by Junior and Senior Companies, 1969-2001



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. [2] Other costs include engineering, economic and pre- or production feasibility studies, environment, and land access. [3] Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures.
Notes: Total exploration expenditures for 1975-81 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. Expenditures for 1997 to 2001 include both exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking). Data for 2000 are preliminary estimates; data for 2001 are company spending intentions.

Figure 3
Selected Measures of Exploration Activity

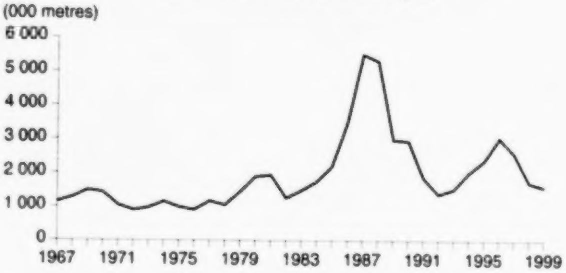
Area of New Mineral Claims Staked or Recorded, 1967-2000



Source: Information obtained and compiled annually by Natural Resources Canada from provincial and territorial mining recorders.

Surface Diamond Drilling, 1967-99

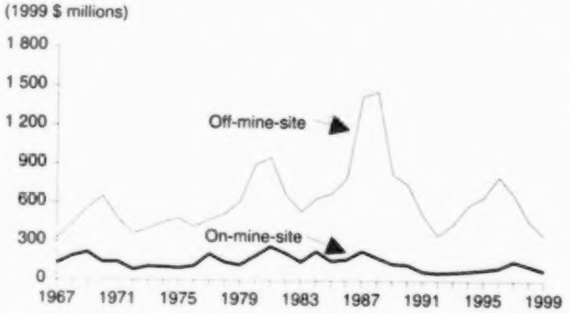
(all minerals except oil and gas)



Sources: 1967-84, Statistics Canada (cat. no. 26-201); 1985-99, from a federal-provincial-territorial survey of mining and exploration companies.
Note: Drilling statistics for 1967-84 are not strictly comparable to and may be understated relative to those for 1985-99.

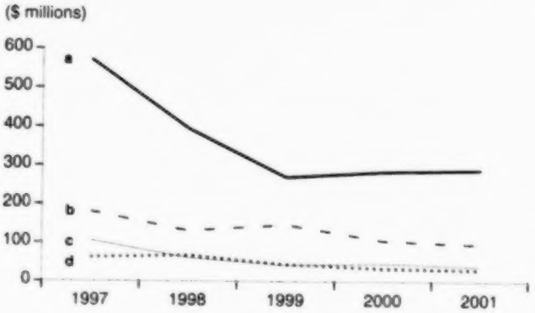
Exploration Plus Deposit Appraisal, Field Work Plus Overhead Expenditures, 1967-99

(all minerals except oil and gas)



Sources: 1967-84, Statistics Canada, *Exploration, Development and Capital Expenditures for Petroleum and Natural Gas Wells, Intentions* (cat. no. 61-216); 1985-99, from a federal-provincial-territorial survey of mining and exploration companies.
Notes: Adjusted to 1999 dollars using Gross Domestic Product deflator series. These expenditures do not include expenditures for oil and gas exploration. Expenditures for 1997-99 include exploration plus deposit appraisal as per new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). Off-mine-site and on-mine-site overhead expenditures for 1967-88 were estimated based on an average from the years 1989-96.

Exploration Plus Deposit Appraisal Expenditures,[1] On- and Off-Mine Site, 1997-2001

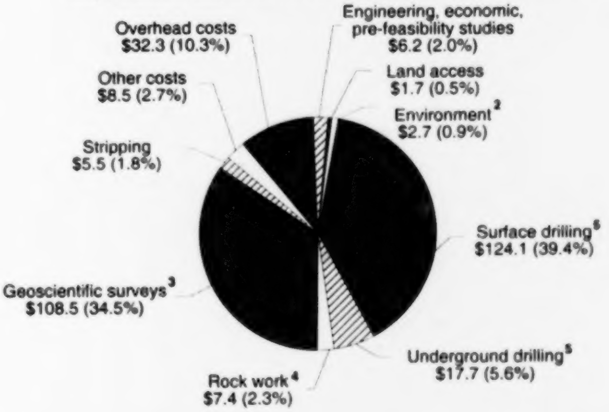


Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[a] Exploration, off-mine-site. [b] Deposit appraisal, off-mine-site. [c] Deposit appraisal, on-mine-site. [d] Exploration, on-mine-site.
[1] Includes field work, overhead, engineering, economic, pre- or production feasibility studies, environment and land access expenditures.
Note: Data for 2000 are preliminary estimates and data for 2001 are company spending intentions.

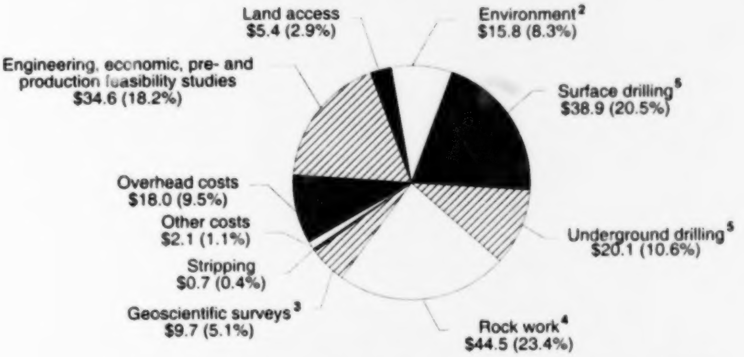
Figure 4
Exploration, Deposit Appraisal and Mine Development Expenditures,[1] by Type of Work, 1999

($ millions)

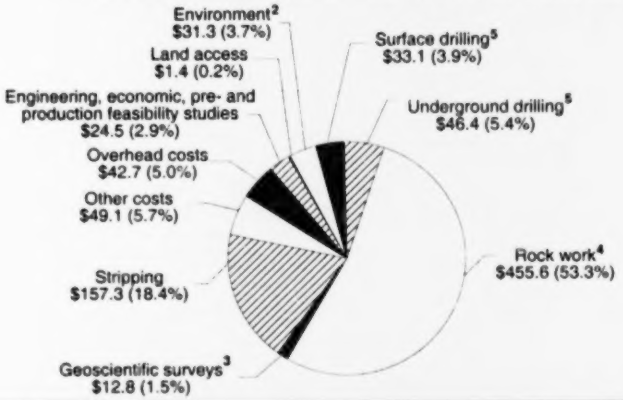
Exploration Expenditures by Type of Work, $314.7



Deposit Appraisal Expenditures by Type of Work, $189.7



Mine Development Expenditures by Type of Work, $854.2

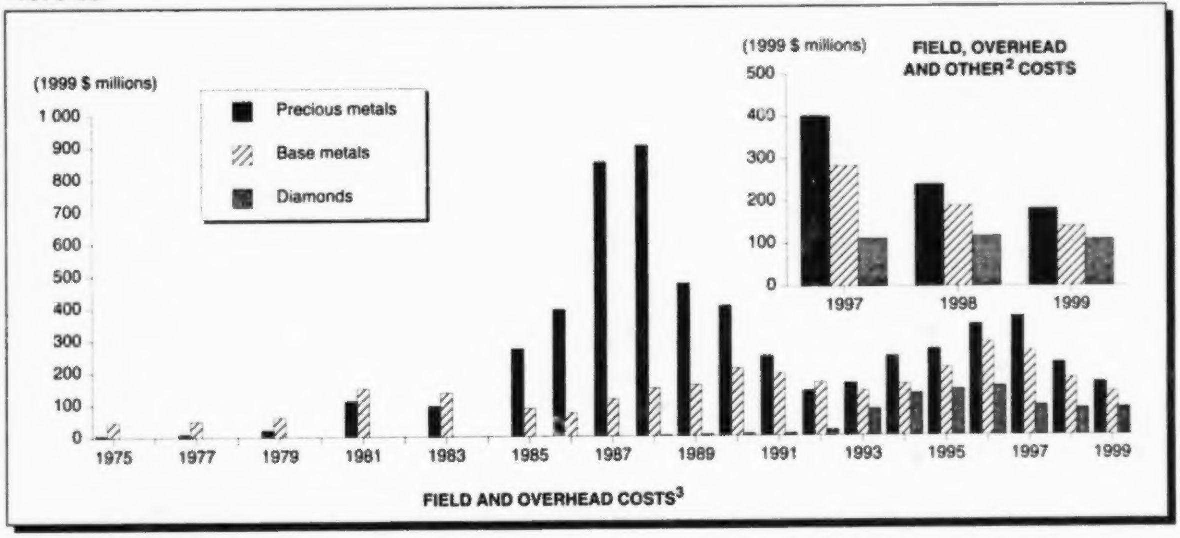


Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. [2] Environment includes characterization, permitting, protection, monitoring and restoration. [3] Geoscientific surveys include geology, geochemistry, ground geophysics and airborne geophysics. [4] Rock work activity includes shaft work, drifts, cross-cuts, raises, declines, rock sampling and dewatering costs. [5] Drilling includes diamond and other types of drilling.

Figure 5

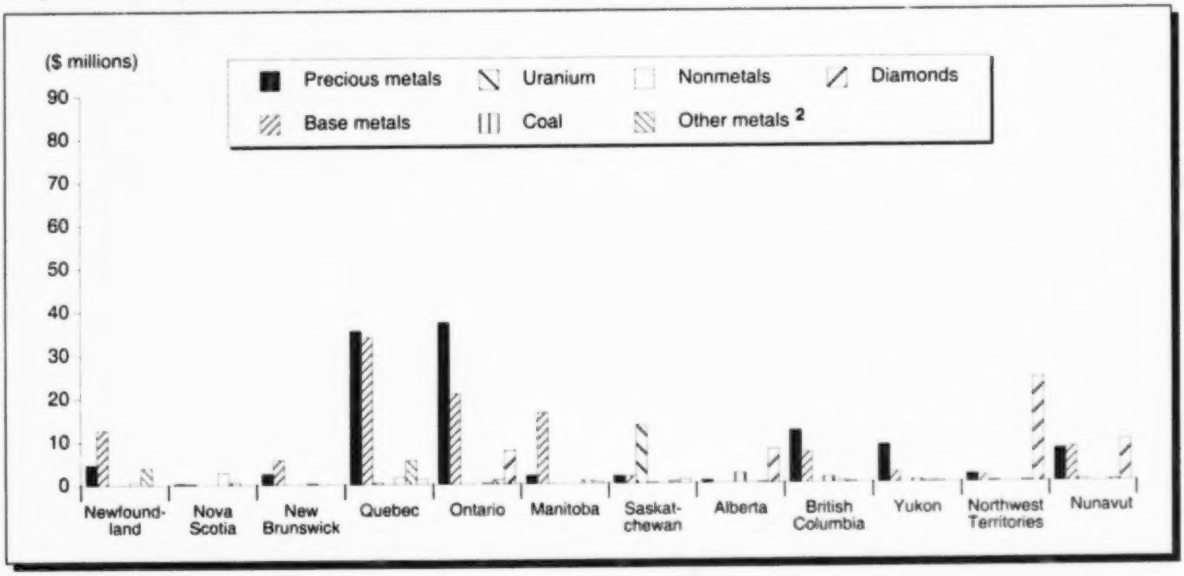
Exploration Plus Deposit Appraisal Expenditures,[1] for Base Metals, Precious Metals and Diamonds, 1975-99



Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off mine-site expenditures; 1997-99 expenditures include both exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). [2]Other costs include engineering, economic and pre- or production feasibility studies, environment, and land access. [3]Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures.
Note: Data have not been compiled for 1976, 1978, 1980, 1982 and 1984.

Figure 6a

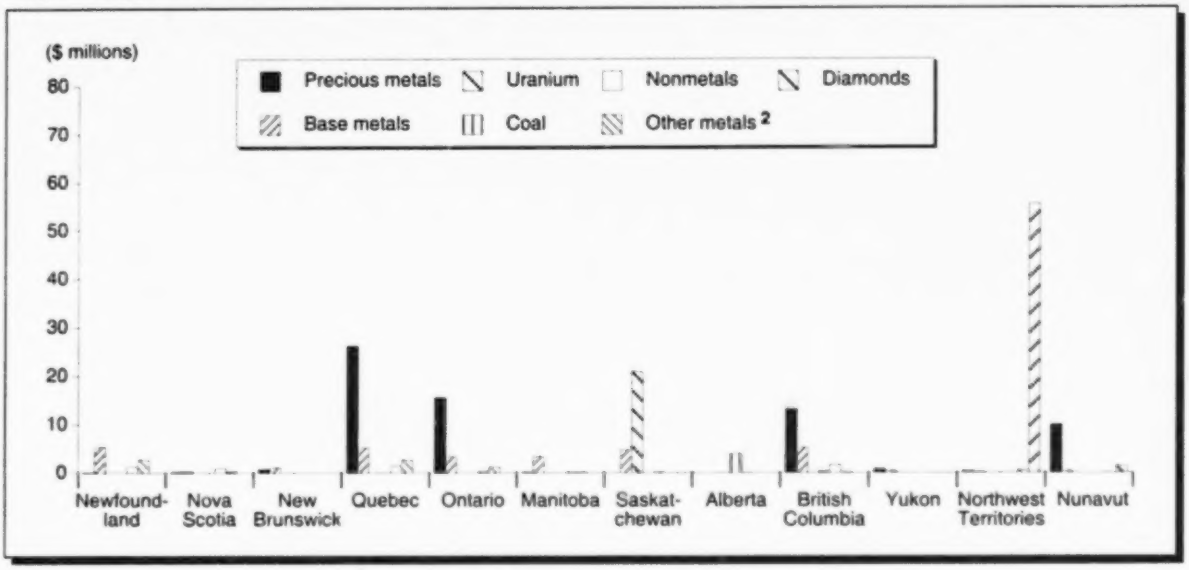
Exploration Expenditures[1] by Province and Territory, by Mineral Commodity Sought, 1999



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

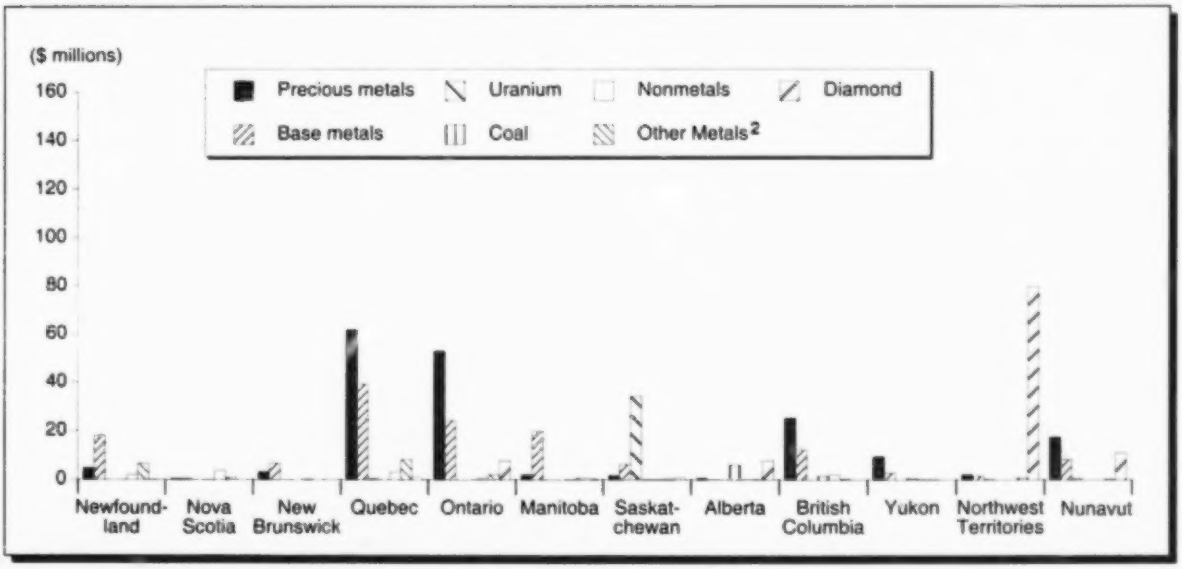
Figure 6b
Deposit Appraisal Expenditures[1] by Province and Territory, by Mineral Commodity Sought, 1999



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

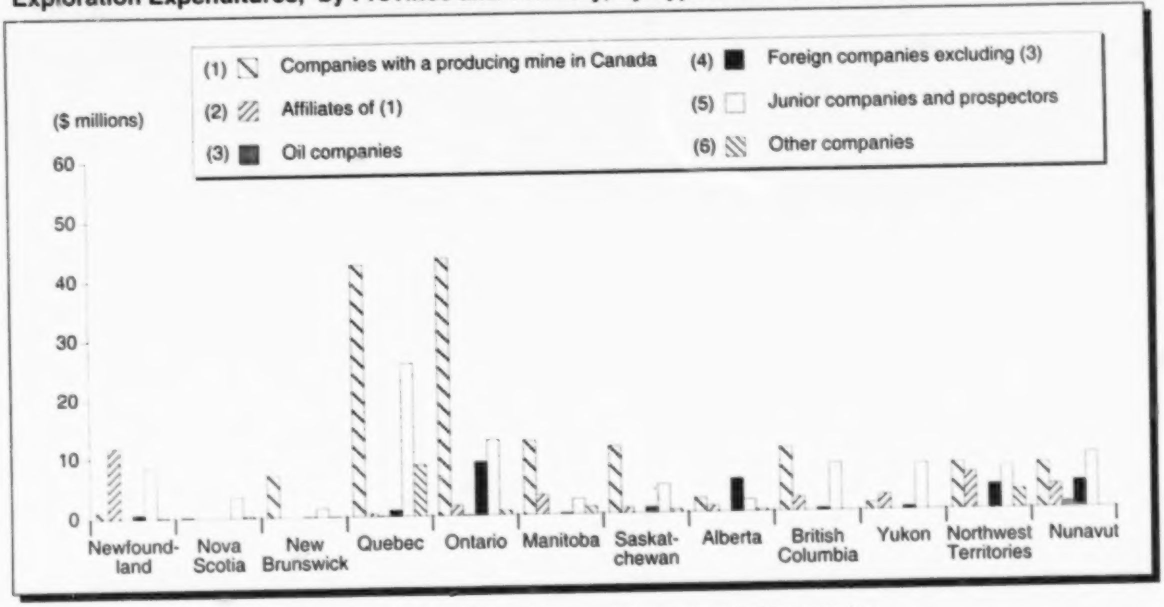
Figure 6c
Exploration Plus Deposit Appraisal Expenditures,[1] by Province and Territory, by Mineral Commodity Sought, 1999



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

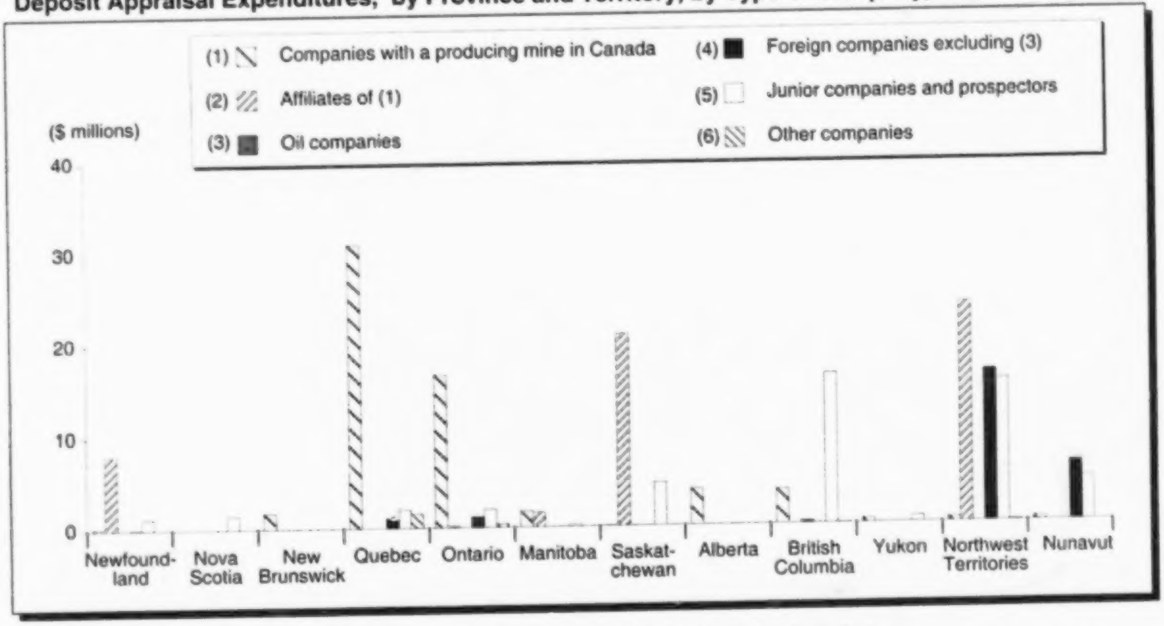
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 7a
Exploration Expenditures,[1] by Province and Territory, by Type of Company, 1999



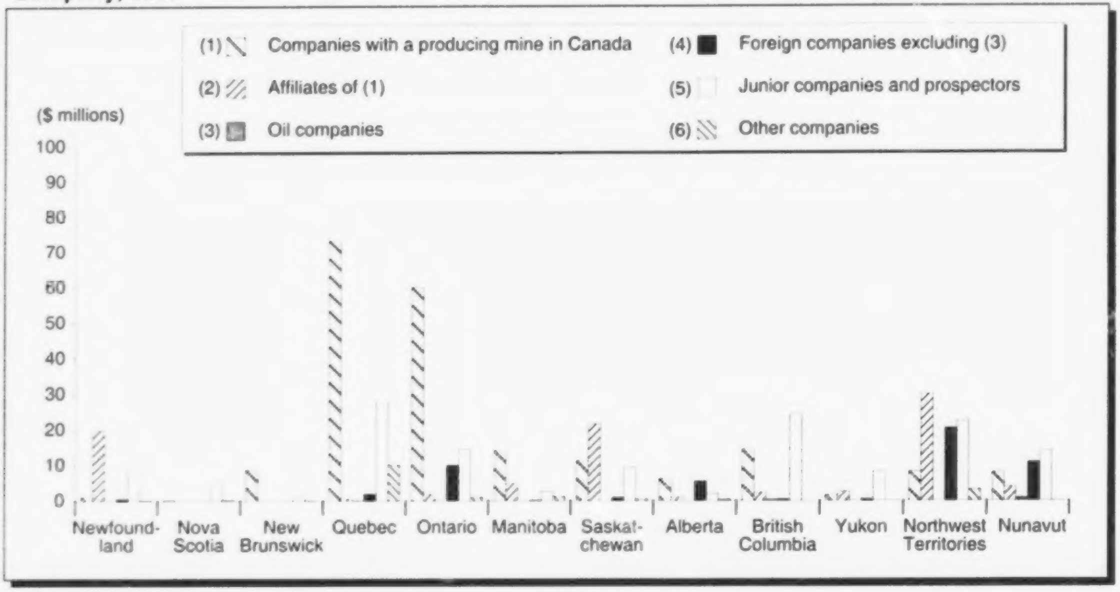
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures.

Figure 7b
Deposit Appraisal Expenditures,[1] by Province and Territory, by Type of Company, 1999



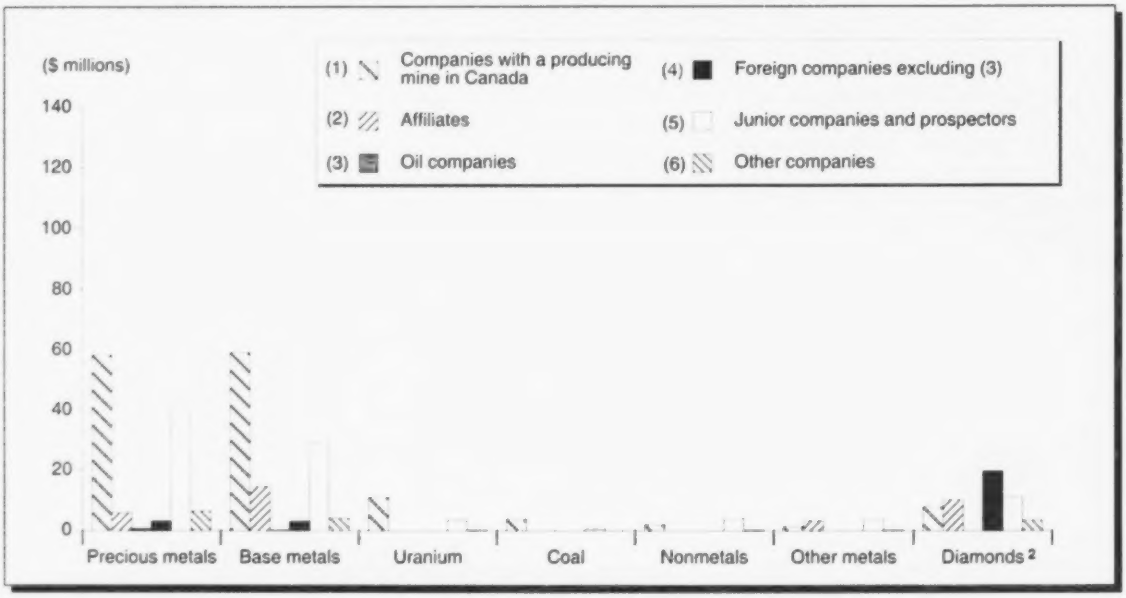
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Figure 7c
Exploration Plus Deposit Appraisal Expenditures,[1] by Province and Territory, by Type of Company, 1999



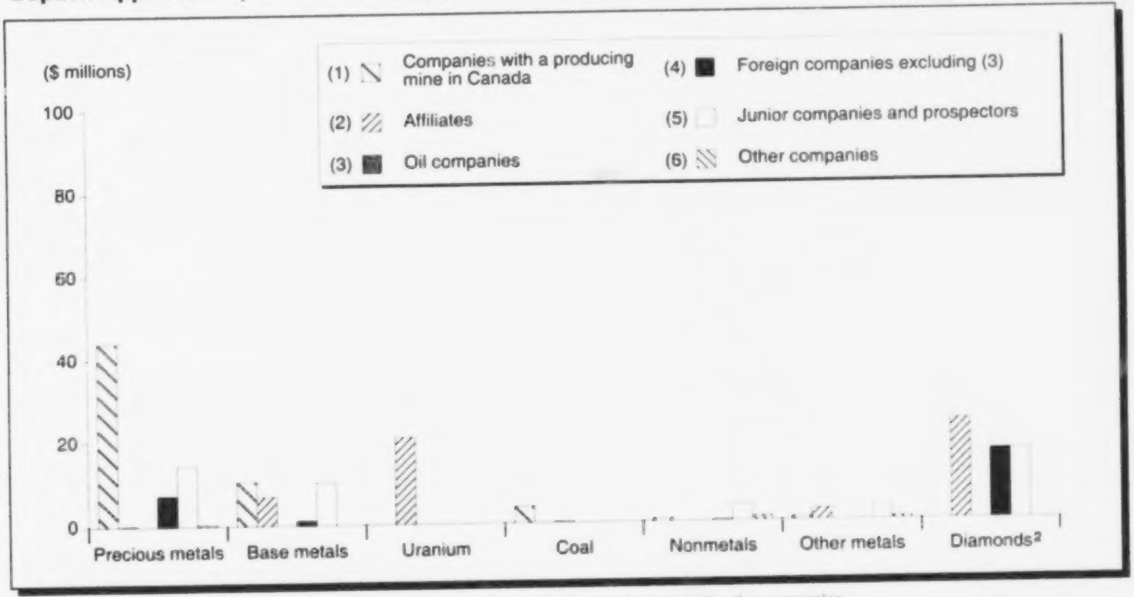
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Figure 8a
Exploration Expenditures,[1] by Type of Company and Mineral Commodity, 1999



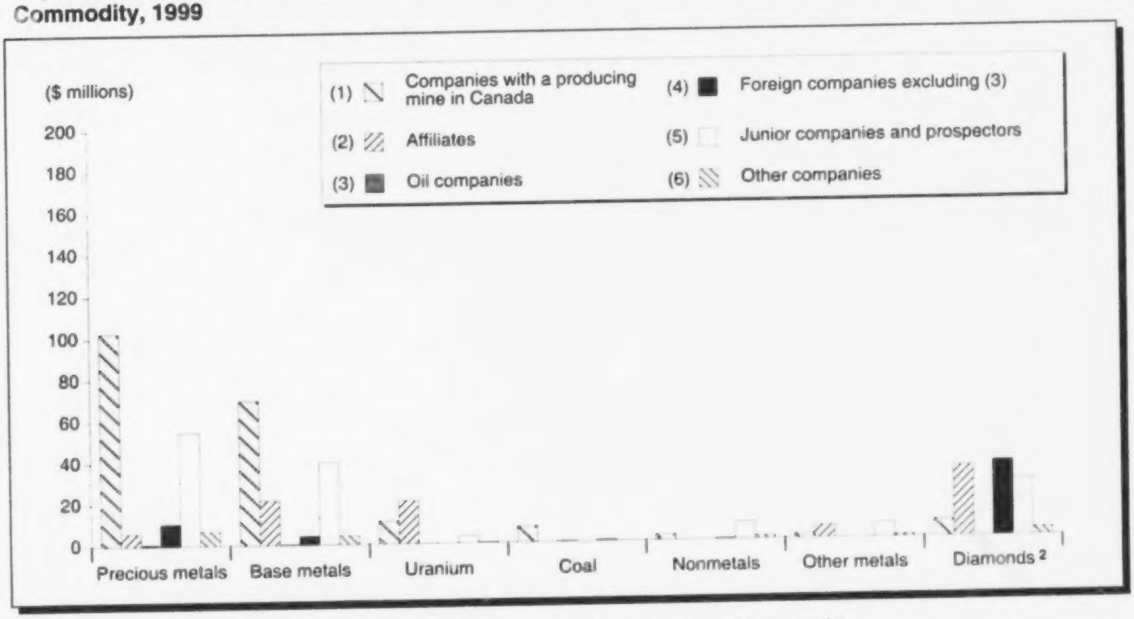
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 8b
Deposit Appraisal Expenditures,[1] by Type of Company and Mineral Commodity, 1999



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 8c
Exploration Plus Deposit Appraisal Expenditures,[1] by Type of Company and Mineral Commodity, 1999



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

TABLE 1. COMPARISON OF 1998 AND 1999 EXPENDITURES,[1] ON- AND OFF-MINE-SITE ACTIVITY FOR EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT

Expenditure Category	1998					1999				
	Off-Mine-Site		On-Mine-Site		Total	Off-Mine-Site		On-Mine-Site		Total
	($ millions)	(%)	($ millions)	(%)	($ millions)	($ millions)	(%)	($ millions)	(%)	($ millions)
EXPLORATION										
Field work and overhead	385.9	86.7	59.2	13.3	445.1	260.7	85.8	43.2	14.2	304.0
Engineering, economic and feasibility studies, evnironment, and land access	9.0	50.9	8.7	49.1	17.7	9.4	88.3	1.3	11.7	10.7
Subtotal	394.9	85.3	67.9	14.7	462.8	270.2	85.9	44.5	14.1	314.7
Capital[2]	7.8	80.4	1.9	19.6	9.7	4.0	80.7	1.0	19.3	4.9
Repair and maintenance[2]	1.2	25.2	3.6	74.8	4.8	2.3	48.2	2.5	51.8	4.8
DEPOSIT APPRAISAL										
Field work and overhead	73.2	55.9	57.7	44.1	130.9	96.0	71.7	37.9	28.3	133.9
Engineering, economic and feasibility studies, evnironment, and land access	58.4	93.8	3.9	6.2	62.3	51.4	92.0	4.4	8.0	55.8
Subtotal	131.6	68.1	61.5	31.9	193.1	147.4	77.7	42.3	22.3	189.7
Capital[2]	16.4	65.4	8.7	34.6	25.1	29.1	100.0	–	–	29.1
Repair and maintenance[2]	11.6	64.6	6.4	35.4	18.0	15.8	95.4	0.8	4.6	16.6
EXPLORATION PLUS DEPOSIT APPRAISAL										
Field work and overhead	459.1	79.7	116.8	20.3	575.9	356.8	81.5	81.1	18.5	437.9
Engineering, economic and feasibility studies, evnironment, and land access	67.4	84.3	12.6	15.7	80.0	60.8	91.4	5.7	8.6	66.5
Subtotal	526.5	80.3	129.4	19.7	655.9	417.6	82.8	86.8	17.2	504.3
Capital[2]	24.2	69.6	10.6	30.4	34.8	33.1	97.2	1.0	2.8	34.0
Repair and maintenance[2]	12.9	56.3	10.0	43.7	22.8	18.1	84.8	3.3	15.2	21.4
MINE COMPLEX DEVELOPMENT										
Field work and overhead	n.a.	n.a.	932.3	100.0	932.3	n.a.	n.a.	797.0	100.0	797.0
Engineering, economic and feasibility studies, evnironment, and land access	n.a.	n.a.	33.8	100.0	33.8	n.a.	n.a.	57.2	100.0	57.2
Subtotal	n.a.	n.a.	966.1	100.0	966.1	n.a.	n.a.	854.2	100.0	854.2
Capital[2]	n.a.	n.a.	1 226.3	100.0	1 226.3	n.a.	n.a.	840.5	100.0	840.5
Repair and maintenance[2]	n.a.	n.a.	1 671.6	100.0	1 671.6	n.a.	n.a.	1 269.7	100.0	1 269.7
Total	563.6	12.3	4 014.0	87.7	4 577.6	468.8	13.3	3 055.4	86.7	3 524.2

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable.

[1] Includes engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes construction, and machinery and equipment expenditures, as well as related environmental protection and restoration expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 2a. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1999

Expenditure Category	Exploration	Deposit Appraisal	Exploration Plus Deposit Appraisal	Mine Complex Development	Total
			($000)		
Field work and overhead[2]	303 963	133 889	437 852[■]	796 957	1 234 809
Engineering studies	3 498	26 478	29 976	21 407	51 383
Economic studies	397	904	1 301	62	1 363
Pre- or production feasibility studies	2 354	7 186	9 540	3 009	12 549
Environment	2 744	15 782	18 526	31 297	49 824
Land access	1 703	5 449	7 152	1 428	8 580
Subtotal	314 660	189 688	504 348	854 160	1 358 508
Off-mine-site[3]	270 188	147 386	417 575	n.a.	417 575
On-mine-site[3]	44 471	42 302	86 773	854 160	940 933
Capital[4]	4 929	29 107	34 035	840 541	874 576
Total	319 589	218 795	538 383	1 694 701	2 233 084
Repair and maintenance[4]	4 835	16 564	21 399	1 269 740	1 291 139
Grand total	324 423	235 359	559 782	2 964 441	3 524 223

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
n.a. Not applicable.
[■] This total can be compared to some extent with exploration expenditures prior to 1997.
[1] Includes on-mine-site plus off-mine-site activities; exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves. [2] Overhead expenditures include mineral leases, claims and property taxes, and project-related head office expenditures. [3] Amount of expenditures dedicated to off-mine-site and on-mine-site activities. [4] Includes construction and machinery and equipment expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 2b. SUMMARY OF ENVIRONMENT EXPENDITURES FOR EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT, 1999

Expenditure Category	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Mine Complex Development		Grand Total[1]	
	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
Environment										
Characterization	1 519	55.2	3 937	23.6	5 455	28.1	1 791	1.9	7 246	6.5
Permits	158	5.8	5 857	35.1	6 015	31.0	941	1.0	6 956	6.2
Protection	97	3.5	2 629	15.8	2 726	14.0	19 648	21.4	22 374	20.1
Restoration	970	35.3	3 360	20.1	4 330	22.3	8 917	9.7	13 247	11.9
Subtotal	2 744		15 782		18 526		31 297		49 824	
Capital, share of environment	–	–	889	5.3	889	4.6	25 570	27.8	26 459	23.8
Repair and maintenance, share of environment	5	0.2	5	–	10	0.1	35 048	38.1	35 058	31.5
Total environment	2 749	100.0	16 676	100.0	19 425	100.0	91 915	100.0	111 341	100.0
Total environment as a percentage of grand total[1]		0.9		7.1		3.5		3.1		3.2

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Grand total refers to Table 2a.
Note: Numbers may not add to totals due to rounding.

TABLE 2c. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 2000 AND 2001

Expenditure Category	Exploration 2000	Exploration 2001	Deposit Appraisal 2000	Deposit Appraisal 2001	Exploration Plus Deposit Appraisal 2000	Exploration Plus Deposit Appraisal 2001	Mine Complex Development 2000	Mine Complex Development 2001	Grand Total 2000	Grand Total 2001
					($000)					
Field work and overhead[2]	309 465	312 136	126 744	107 758	436 209[a]	419 894[a]	711 721	659 430	1 147 930	1 079 325
Engineering, economic and pre- or production feasibility studies	5 656	4 753	20 680	20 941	26 336	25 693	41 120	31 487	67 456	57 181
Environment	3 055	2 821	4 910	5 862	7 965	8 682	13 589	16 196	21 554	24 878
Land access	1 414	1 628	1 444	1 837	2 858	3 465	9 964	847	12 823	4 311
Subtotal	319 590	321 338	153 778	136 397	473 368	457 734	776 394	707 960	1 249 762	1 165 695
Off-mine-site	284 891	289 965	106 534	96 814	391 425	386 778	n.a.	n.a.	391 425	386 778
On-mine-site	34 699	31 373	47 244	39 583	81 943	70 956	776 394	707 960	858 337	778 916
Capital[3]	1 418	2 093	20 688	33 810	22 106	35 903	1 124 740	1 439 510	1 146 846	1 475 414
$ for environmental protection and restoration[4]	383	293	812	1 020	1 195	1 313	50 455	49 649	51 650	50 962
Repair and maintenance[3]	3 377	381	7 719	5 877	11 096	6 258	1 192 727	1 145 760	1 203 823	1 152 018
$ for environmental protection and restoration[4]	29	51	2 068	3 830	2 097	3 881	62 079	65 486	64 177	69 367
Subtotal	4 795	2 474	28 407	39 687	33 202	42 162	2 317 467	2 585 270	2 350 669	2 627 432
Grand total	324 385	323 812	182 185	176 084	506 570	499 896	3 093 861	3 293 230	3 600 432	3 793 126
Total environment	3 467	3 164	7 790	10 711	11 257	13 876	126 123	131 331	137 380	145 207
Environment as a percentage of grand total	1.07	0.98	4.28	6.08	2.22	2.78	4.08	3.99	3.82	3.83

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
n.a. Not applicable.
[a] This total can be compared to some extent with exploration expenditures prior to 1997.
[1] Incudes on-mine-site plus off-mine-site activities; exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves. [2] Overhead expenditures include mineral leases, claims and property taxes, and project-related head office expenditures. [3] Includes construction, and machinery and equipment expenditures. [4] As part of capital expenditures or repair and maintenance expenditures.
Notes: Numbers may not add to totals due to rounding. Data for 2000 are preliminary estimates; data for 2001 are company spending intentions.

TABLE 3a. EXPLORATION PLUS DEPOSIT APPRAISAL, FIELD WORK PLUS OVERHEAD EXPENDITURES,[1] BY JUNIOR AND SENIOR COMPANIES, 1969-2001

Year	Current Dollars: Share of Total Junior	Current Dollars: Share of Total Senior	Current Dollars: Total	Current Dollars: % of Total Junior	Constant 2000 Dollars: Share of Total Junior	Constant 2000 Dollars: Share of Total Senior	Constant 2000 Dollars: Total	Constant 2000 Dollars: % of Total Junior
	($ millions)				($ millions)			
1969	44.4	130.5	174.9	25.4	204.2	600.3	804.5	25.4
1970	39.9	147.2	187.1	21.3	175.0	645.5	820.5	21.3
1971	24.5	127.5	152.0	16.1	103.8	540.2	644.0	16.1
1972	18.3	97.4	115.7	15.8	73.1	389.3	462.4	15.8
1973	22.5	121.6	144.1	15.6	82.3	444.9	527.3	15.6
1974	21.8	158.5	180.3	12.1	69.6	506.0	575.6	12.1
1975	19.5	187.8	207.3	9.4	56.4	542.7	599.0	9.4
1976	13.9	192.9	206.8	6.7	36.8	510.3	547.1	6.7
1977	12.5	271.0	283.5	4.4	31.0	671.2	702.2	4.4
1978	19.8	275.0	294.8	6.7	46.0	639.0	685.0	6.7
1979	29.4	329.5	358.9	8.2	62.4	699.3	761.7	8.2
1980	60.2	530.0	590.2	10.2	115.2	1 014.1	1 129.3	10.2
1981	83.0	651.2	734.2	11.3	143.0	1 122.2	1 265.2	11.3
1982	73.8	502.5	576.3	12.8	117.1	797.6	914.8	12.8
1983	71.2	400.6	471.8	15.1	107.3	603.6	710.9	15.1
1984	146.9	470.4	617.3	23.8	214.2	685.8	900.0	23.8
1985	181.1	424.7	605.8	29.9	257.8	604.3	862.0	29.9
1986	348.6	374.7	723.3	48.2	482.7	518.7	1 001.4	48.2
1987	668.2	631.8	1 300.0	51.4	882.8	834.7	1 717.6	51.4
1988	668.3	681.8	1 350.1	49.5	844.4	861.4	1 705.8	49.5
1989	272.6	555.3	827.9	32.9	329.3	670.8	1 000.0	32.9
1990	241.0	533.7	774.7	31.1	282.6	625.9	908.5	31.1
1991	116.1	415.6	531.8	21.8	132.6	474.6	607.2	21.8
1992	79.9	305.4	385.3	20.7	90.1	344.2	434.2	20.7
1993	142.7	334.5	477.3	29.9	158.5	371.4	529.9	29.9
1994	195.8	432.3	628.1	31.2	215.1	474.9	689.9	31.2
1995	213.4	504.2	717.6	29.7	229.3	541.7	771.0	29.7
1996	313.9	580.9	894.8	35.1	332.4	612.6	945.1	35.2
1997	266.7	553.4	820.2	32.5	279.1	579.2	858.3	32.5
1998	155.9	420.0	575.9	27.1	164.1	442.0	606.0	27.1
1999	123.1	314.8	437.9	28.1	127.5	326.1	453.5	28.1
2000[p]	132.6	303.6	436.2	30.4	132.6	303.6	436.2	30.4
2001[f]	152.3	267.6	419.9	36.3	152.3	267.6	419.9	36.3

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[f] Forecast; [p] Preliminary.
[1] Includes on-mine-site plus off-mine-site activities.
Note: Expenditures starting in 1997 include exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking).

TABLE 3b. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY JUNIOR AND SENIOR COMPANIES, 1997-2001

	Current Dollars				Constant 2000 Dollars			
	Share of Total			% of Total	Share of Total			% of Total
Year	Junior	Senior	Total	Junior	Junior	Senior	Total	Junior
	($ millions)				($ millions)			
1997	298.0	623.0	921.0	32.4	311.8	651.9	963.7	32.4
1998	170.5	485.4	655.9	26.0	179.5	510.8	690.2	26.0
1999	141.2	363.2	504.3	28.0	146.2	376.2	522.4	28.0
2000[p]	148.6	324.8	473.4	31.4	148.6	324.8	473.4	31.4
2001[f]	166.6	291.2	457.7	36.4	166.6	291.2	457.7	36.4

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[f] Forecast; [p] Preliminary.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

TABLE 4. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY RANGE OF EXPENDITURES AND BY JUNIOR AND SENIOR COMPANIES, 1998-2000

	Junior			Senior			Total		
Range of Expenditures	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures
($)	(number)	($000)	(%)	(number)	($000)	(%)	(number)	($000)	(%)
1998									
>10 million	–	–	–	15	298 116	61.4	15	298 116	45.4
5 million - 10 million	3	23 878	14.0	13	98 355	20.3	16	122 233	18.6
1 million - 5 million	31	60 521	35.5	29	70 573	14.5	60	131 094	20.0
500 000 - 1 million	48	33 083	19.4	15	10 881	2.2	63	43 964	6.7
200 000 - 500 000	91	29 145	17.1	15	4 786	1.0	106	33 931	5.2
100 000 - 200 000	82	12 290	7.2	12	1 811	0.4	94	14 101	2.1
50 000 - 100 000	50	3 940	2.3	5	413	0.1	55	4 353	0.7
1 - 50 000	174	3 142	1.8	21	452	0.1	195	3 594	0.5
Subtotal	479	165 999	97.3	125	485 387	100.0	604	651 387	99.3
Prospectors	43	4 544	2.7	–	–	–	43	4 544	0.7
Total 1998	522	170 544	100.0	125	485 387	100.0	647	655 931	100.0
1999									
>10 million	2	29 101	20.6	10	190 759	52.5	12	219 860	43.6
5 million - 10 million	1	5 234	3.7	12	91 230	25.1	13	96 464	19.1
1 million - 5 million	21	37 727	26.7	26	63 308	17.4	47	101 035	20.0
500 000 - 1 million	38	26 929	19.1	14	10 632	2.9	52	37 560	7.4
200 000 - 500 000	82	25 574	18.1	14	4 235	1.2	96	29 809	5.9
100 000 - 200 000	54	7 603	5.4	13	1 840	0.5	67	9 444	1.9
50 000 - 100 000	48	3 492	2.5	11	769	0.2	59	4 261	0.8
1 - 50 000	163	2 746	1.9	23	398	0.1	186	3 145	0.6
Subtotal	409	138 407	98.0	123	363 170	100.0	532	501 578	99.5
Prospectors	25	2 770	2.0	–	–	–	25	2 770	0.5
Total 1999	434	141 177	100.0	123	363 170	100.0	557	504 348	100.0
2000[p]									
>10 million	1	17 596	11.8	7	149 352	46.0	8	166 948	35.3
5 million - 10 million	–	–	–	13	92 943	28.6	13	92 943	19.6
1 million - 5 million	32	65 528	44.1	29	68 399	21.1	61	133 926	28.3
500 000 - 1 million	39	25 767	17.3	9	6 128	1.9	48	31 895	6.7
200 000 - 500 000	73	23 470	15.8	17	4 938	1.5	90	28 408	6.0
100 000 - 200 000	55	7 348	4.9	14	1 889	0.6	69	9 237	2.0
50 000 - 100 000	48	3 188	2.1	13	879	0.3	61	4 068	0.9
1 - 50 000	131	2 162	1.5	16	232	0.1	147	2 394	0.5
Subtotal	379	145 058	97.6	118	324 760	100.0	497	469 819	99.3
Prospectors	32	3 549	2.4	–	–	–	32	3 549	0.7
Total 2000	411	148 608	100.0	118	324 760	100.0	529	473 368	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil; [p] Preliminary.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 5. SUMMARY OF TOTAL DIAMOND EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1998-2000

Expenditure Category	1998	1999	2000[p]
		($ millions)	
Field work and overhead	148.9	83.9	141.6
Engineering, economic and pre- or production feasibility studies, environment and land access	36.7	25.0	56.5
Capital and repair[2]	161.4	76.0	229.3
Total	347.1	185.0	427.4

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[p] Preliminary.

[1] Includes on-mine-site plus off-mine-site activities. [2] Includes construction, and machinery and equipment expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 6a. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED IN CANADA, 1993-2000

Province/Territory	1993		1994		1995		1996		1997		1998		1999		2000	
	(hectares)	(%)[2]	(hectares)	(%)[3]	(hectares)	(%)[4]	(hectares)	(%)[5]	(hectares)	(%)[6]	(hectares)	(%)[7]	(hectares)	(%)[8]	(hectares)	(%)[10]
Newfoundland	127 282	132.0	513 903	403.8	6 106 617	1188.3	417 575	6.8	334 075	80.0	361 900	108.3	241 075	66.6	324 225	134.5
Nova Scotia	87 350	42.4	154 123	176.4	183 893	119.3	424 815	231.0	208 191	49.0	74 180	35.6	157 394	212.2	95 819	61.5
New Brunswick	37 616	68.3	63 680	169.3	60 464	94.9	93 760	155.1	53 760	57.3	40 000	74.4	28 336	70.8	49 344	174.1
Quebec	691 915	124.6	840 922	121.5	1 474 196	175.3	954 967	64.8	1 050 629	110.0	728 142	69.3	754 102	103.6	2 187 551	290.1
Ontario	426 416	85.7	734 400	172.2	668 832	91.1	903 488	135.1	855 584	94.7	577 632	67.5	604 096	104.6	874 896	144.8
Manitoba	831 168[b]	81.9	1 391 641[b]	167.4	670 316[b]	48.2	325 452[b]	48.6	386 243[b]	118.7	475 634	123.1	566 571	119.1	1 832 577	323.5
Saskatchewan	2 257 219	251.6	1 815 997	80.5	340 881	18.8	469 040	137.6	950 253	202.6	680 048	71.6	161 083[c]	23.7	523 440	325.0
Alberta	10 260 000	46.0	6 750 000	65.8	1 665 000	24.7	5 328 000	320.0	37 200 000	698.2	3 490 000	9.4	1 026 000	29.4	2 349 600	229.0
British Columbia	702 250[a]	85.2	774 340	110.3	845 550	109.2	997 740	118.0	765 257	76.7	474 296	62.0	478 740	100.9	699 050	146.0
Yukon	114 817	84.5	280 171	244.0	376 844	134.5	514 483	136.5	459 507	89.3	131 221	28.5	152 731	116.4	52 675	34.5
Northwest Territories	11 812 417	164.6	2 929 482	24.8	3 839 299	131.1	2 956 017	77.0	1 953 191	66.1	827 615	42.4	563 378	68.1[9]	891 419	158.2
Nunavut	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	710 092	. .	498 230	70.2
Total	27 348 450	81.0	16 248 659	59.4	16 231 892	99.9	13 385 337	82.5	44 216 690	330.3	7 860 668	17.8	5 443 598	69.3	10 379 826	190.7

Source: Provincial and territorial mining recorders.

. . Not available.

[a] Not strictly comparable to 1990 and earlier years because the total is the area of claims recorded and not the area of claims staked. [b] Data for Manitoba are revised. [c] Prior to 1999, Saskatchewan data do not include exploration permits.

[1] Excludes coal. [2] Percentage of 1993 over 1992. [3] Percentage of 1994 over 1993. [4] Percentage of 1995 over 1994. [5] Percentage of 1996 over 1995. [6] Percentage of 1997 over 1996. [7] Percentage of 1998 over 1997. [8] Percentage of 1999 over 1998. [9] Percentage based on new claims staked in 1999 in the Northwest Territories and Nunavut combined. [10] Percentage of 2000 over 1999.

Note: Numbers may not add to totals due to rounding.

TABLE 6b. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED IN CANADA, 1998-2000

Province/Territory	1998		1999		2000	
	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)
Newfoundland	361 900	4.6	241 075	4.4	324 225	3.1
Nova Scotia	74 180	0.9	157 394	2.9	96 819	0.9
New Brunswick	40 000	0.5	28 336	0.5	49 344	0.5
Quebec	728 142	9.3	754 102	13.9	2 187 551	21.1
Ontario	577 632	7.3	604 096	11.1	874 896	8.4
Manitoba	475 634	6.1	566 571	10.4	1 832 577	17.7
Saskatchewan	680 048	8.7	161 083r	3.0	523 440	5.0
Alberta	3 490 000	44.4	1 026 000	18.8	2 349 600	22.6
British Columbia	474 296	6.0	478 740	8.8	699 050	6.7
Yukon	131 221	1.7	152 731	2.8	52 675	0.5
Northwest Territories	827 615	10.5	563 378r	10.3	891 419	8.6
Nunavut	. .	. .	710 092r	13.0	498 230	5.0
Total	7 860 668	100.0	5 443 598	100.0	10 379 826	100.0

Source: Provincial and territorial mining recorders.
. . Not available; r Revised.
[1] Excludes coal.
Note: Numbers may not add to totals due to rounding.

TABLE 7. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 1999 AND 2000

Province/Territory	1999						2000p					
	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
	($000)											
Newfoundland	21 858	91	9 228	127	31 086	218	17 320	281	7 285	46	24 605	327
Nova Scotia	3 812	–	1 446	–	5 258	–	2 825	33	180	100	3 005	133
New Brunswick	6 955	1 458	–	1 700	6 955	3 158	8 425	–	6	2 000	8 431	2 000
Quebec	66 632	11 591	8 403	26 921	75 035	38 512	58 857	9 353	6 400	25 957	65 257	35 310
Ontario	43 550	23 727	11 042	9 075	54 592	32 801	42 055	19 329	17 927	10 398	59 982	29 727
Manitoba	18 125	1 279	166	3 277	18 291	4 556	20 366	3 056	1 036	2 987	41 402	6 043
Saskatchewan	17 772	318	25 465	18	43 237	336	23 128	120	13 607	2 297	36 735	2 417
Alberta	10 772	78	3 181	707	13 953	785	7 779	–	–	21	7 779	21
British Columbia	17 066	4 031	20 158	55	37 224	4 086	25 886	2 175	4 111	2 657	29 997	4 832
Yukon	10 893	841	766	244	11 659	1 085	9 461	–	284	76	9 745	76
Northwest Territories	27 885	–	56 237	–	84 123	–	25 267	337	37 232	307	62 499	644
Nunavut	24 869	1 057	11 293	178	36 161	1 236	43 521	15	18 467	398	61 988	413
Total	270 188	44 471	147 386	42 302	417 575	86 773	284 891	34 699	106 534	47 244	391 425	81 943
Total (on- plus off-mine-site)	314 660		189 688		504 348		319 590		153 778		473 368	

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; p Preliminary.
[1] Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 8. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 1998-2001

Province/Territory	1998		1999		1999 as a % of 1998 Expenditures	2000[p]		2000 as a % of 1999 Expenditures	2001[f]		2001 as a % of 2000 Expenditures
	($ millions)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)
Newfoundland	47.9	7.3	31.3	6.2	65.4	24.9	5.3	79.6	24.5	5.4	98.2
Nova Scotia	6.5	1.0	5.3	1.0	80.9	3.1	0.7	59.7	4.6	1.0	146.0
New Brunswick	10.1	1.5	10.1	2.0	100.1	10.4	2.2	103.2	10.3	2.2	98.7
Quebec	127.1	19.4	113.5	22.5	89.3	100.6	21.2	88.6	69.6	15.2	69.2
Ontario	114.8	17.5	87.4	17.3	76.1	89.7	19.0	102.6	99.0	21.6	110.4
Manitoba	29.9	4.6	22.8	4.5	76.4	27.4	5.8	120.1	30.5	6.7	111.0
Saskatchewan	62.1	9.5	43.6	8.6	70.2	39.2	8.3	89.9	41.2	9.0	105.3
Alberta	27.5	4.2	14.7	2.9	53.6	7.8	1.6	52.9	7.8	1.7	100.6
British Columbia	54.5	8.3	41.3	8.2	75.8	34.8	7.4	84.3	45.1	9.9	129.6
Yukon	20.1	3.1	12.7	2.5	63.4	9.8	2.1	77.1	10.7	2.3	109.4
Northwest Territories	155.6	23.7	84.1	16.7	54.1[a]	63.1	13.3	75.1	60.1	13.1	95.2
Nunavut	n.a.	n.a.	37.4	7.4	n.a.	62.4	13.2	166.9	54.2	11.8	86.8
Total	655.9	100.0	504.3	100.0	76.9	473.4	100.0	93.9	457.7	100.0	96.7
Exploration	462.8	70.6	314.7	62.4	68.0	319.6	67.5	101.6	321.3	70.2	100.5
Deposit appraisal	193.1	29.4	189.7	37.6	98.2	153.8	32.5	81.1	136.4	29.8	88.7

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[f] Forecast; n.a. Not applicable; [p] Preliminary.

[a] Data for 1999 Northwest Territories compares the sum of Northwest Territories and Nunavut expenditures in 1999 with the total Northwest Territories expenditure in 1998.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 9a. EXPLORATION ACTIVITY,[1] BY PROVINCE AND TERRITORY, BY TYPE OF WORK, 1999

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work[2]	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland	83	10 894	1	32	489	3 033	2 823	330	368	1 410	224	40	23	2 267	10	6	21 950
Nova Scotia	14	1 563	2	151	255	750	290	7	74	61	40	35	116	390	56	24	3 812
New Brunswick	49	4 953	3	130	100	712	1 345	–	47	87	27	–	–	940	68	2	8 413
Quebec	715	35 816	12	451	2 227	16 173	5 676	1 977	2 776	1 775	1 181	168	2 084	7 413	484	22	78 222
Ontario	462	31 145	7	5 036	1 140	13 892	3 777	431	4 289	977	946	59	80	4 243	451	811	67 277
Manitoba	81	8 701	–	–	1 020	2 501	1 993	630	51	828	–	10	–	3 344	122	5	19 404
Saskatchewan	81	9 973	1	679	396	1 057	1 847	194	147	567	42	1	–	3 176	4	6	18 090
Alberta	8	1 935	20	686	833	1 132	1 087	1 142	235	715	495	–	–	1 571	736	284	10 850
British Columbia	87	7 135	7	539	1 052	5 204	762	67	3 260	384	193	–	17	2 111	328	44	21 097
Yukon	10	2 537	4	774	2 179	3 009	414	388	792	164	83	–	–	1 216	105	73	11 734
Northwest Territories	54	7 138	5	1 801	6 907	2 087	1 981	3 146	48	1 130	258	85	35	2 879	50	340	27 885
Nunavut	49	8 441	1	1 235	2 989	4 843	2 961	1 095	807	413	8	–	–	2 719	329	85	25 926
Total	1 693	130 233	62	11 514	19 588	54 392	24 956	9 607	12 894	8 511	3 498	397	2 354	32 269	2 744	1 703	314 660
Percentage of grand total	n.a.	41.4	n.a.	3.7	6.2	17.3	7.9	3.1	4.1	2.7	1.1	0.1	0.7	10.3	0.9	0.5	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable.
[1] Includes on-mine-site plus off-mine-site activities. [2] Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9b. DEPOSIT APPRAISAL ACTIVITY,[1] BY PROVINCE AND TERRITORY, BY TYPE OF WORK, 1999

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work[2]	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland	39	6 475	–	–	–	125	580	–	15	82	71	25	200	421	593	767	9 355
Nova Scotia	–	–	1	50	8	–	–	–	–	–	1 018	10	191	34	135	1	1 446
New Brunswick	33	1 700	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1 700
Quebec	181	8 794	. . .	13	138	824	245	88	17 652	139	1 669	330	1 324	1 186	2 493	431	35 325
Ontario	179	11 847	–	–	–	1 992	55	–	1 304	68	127	30	3 458	936	223	77	20 117
Manitoba	30	2 154	–	–	40	67	195	–	55	545	84	–	–	276	27	–	3 443
Saskatchewan	31	3 974	–	–	110	734	77	–	10 817	188	4 353	–	779	2 021	2 209	221	25 483
Alberta	–	–	115	1 030	–	167	122	–	–	168	169	168	–	587	1 478	–	3 888
British Columbia	19	1 420	–	–	2	475	7	–	9 887	114	3 852	232	557	966	1 593	1 108	20 213
Yukon	1	104	1	195	27	19	10	–	21	30	–	10	122	347	121	4	1 010
Northwest Territories	41	7 147	10	9 928	244	179	279	16	5 080	754	13 873	99	355	10 211	5 282	2 792	56 237
Nunavut	30	4 132	–	–	425	2 440	–	–	363	–	1 262	–	200	973	1 629	48	11 471
Total	583	47 747	127	11 215	994	7 020	1 570	104	45 193	2 088	26 478	904	7 186	17 958	15 782	5 449	189 688
Percentage of grand total	n.a.	25.2	n.a.	5.9	0.5	3.7	0.8	0.1	23.8	1.1	14.0	0.5	3.8	9.5	8.3	2.9	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
[1] Includes on-mine-site plus off-mine-site activities. [2] Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9c. EXPLORATION PLUS DEPOSIT APPRAISAL ACTIVITIES,[1] BY PROVINCE AND TERRITORY, BY TYPE OF WORK, 1999

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work[2]	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland	122	17 369	1	32	489	3 158	3 404	330	383	1 492	295	65	223	2 688	604	773	31 305
Nova Scotia	14	1 563	3	201	262	750	290	7	74	61	1 058	45	307	424	191	25	5 258
New Brunswick	82	6 653	3	130	100	712	1 345	–	47	87	27	–	–	940	68	2	10 113
Quebec	896	44 610	12	464	2 366	16 996	5 921	2 065	20 428	1 913	2 850	498	3 408	8 599	2 977	452	113 547
Ontario	642	42 993	7	5 036	1 140	15 884	3 832	431	5 592	1 044	1 073	89	3 538	5 179	674	888	87 393
Manitoba	111	10 855	–	–	1 060	2 568	2 187	830	106	1 373	84	10	–	3 620	149	5	22 847
Saskatchewan	112	13 947	1	679	506	1 791	1 925	194	10 965	755	4 395	1	779	5 197	2 213	227	43 573
Alberta	8	1 935	135	1 715	833	1 298	1 209	1 142	235	883	664	168	–	2 158	2 214	284	14 739
British Columbia	106	8 555	7	539	1 054	5 679	769	67	13 147	499	4 045	232	575	3 077	1 921	1 152	41 310
Yukon	11	2 642	5	969	2 207	3 028	424	388	813	194	83	10	122	1 563	226	77	12 744
Northwest Territories	95	14 285	15	11 729	7 151	2 266	2 260	3 162	5 128	1 884	14 131	184	390	13 090	5 332	3 132	84 123
Nunavut	79	12 573	1	1 235	3 414	7 282	2 961	1 095	1 170	413	1 270	–	200	3 692	1 958	133	37 397
Total	2 277	177 980	189	22 729	20 582	61 413	26 526	9 710	58 087	10 599	29 976	1 301	9 540	50 226	18 526	7 152	504 348
Percentage of grand total	n.a.	35.3	n.a.	4.5	4.1	12.2	5.3	1.9	11.5	2.1	5.9	0.3	1.9	10.0	3.7	1.4	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable.
[1] Includes on-mine-site plus off-mine-site activities. [2] Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9d. MINE DEVELOPMENT ACTIVITY,[1] BY PROVINCE AND TERRITORY, BY TYPE OF WORK, 1999

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work[2]	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland	7	391	128	2 349	33	57	–	–	5 406	207	104	–	10	77	783	11	9 427
Nova Scotia	3	447	139	390	–	177	11	–	3 391	125	221	25	–	340	1 151	31	6 309
New Brunswick	136	5 562	212	8 380	31	31	578	–	25 848	–	–	–	–	59	88	200	40 778
Quebec	230	16 469	31	1 839	109	2 355	28	–	263 342	27 984	14 142	–	2 750	21 390	9 277	631	360 316
Ontario	476	20 658	164	4 717	246	4 706	62	–	181 489	12	993	–	–	3 295	9 256	1	225 434
Manitoba	90	3 795	–	–	273	472	–	–	26 628	9 098	486	–	–	1 048	50	–	41 850
Saskatchewan	7	1 369	22	358	–	–	1 002	–	58 685	11 440	1 054	–	–	9 407	5 234	19	88 568
Alberta	2	173	37	1 079	–	117	10	–	23 999	174	312	37	54	3 681	2 169	42	31 845
British Columbia	76	6 044	107	5 406	574	1 268	–	–	18 592	–	3 677	–	195	1 481	2 747	495	40 479
Yukon	–	–	–	–	–	–	–	–	–	–	–	–	–	50	–	–	50
Northwest Territories	2	46	–	–	–	656	–	–	5 143	–	410	–	–	1 763	284	–	8 302
Nunavut	–	–	–	–	–	21	–	–	425	11	8	–	–	78	258	–	801
Total	1 027	54 955	839	24 518	1 265	9 859	1 691	–	612 948	49 051	21 407	62	3 009	42 671	31 297	1 428	854 160
Percentage of grand total	n.a.	6.4	n.a.	2.9	0.1	1.2	0.2	–	71.8	5.7	2.5	. . .	0.4	5.0	3.7	0.2	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
[1] Includes on-mine-site activities. [2] Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-waterings costs.
Note: Numbers may not add to totals due to rounding.

TABLE 10. SUMMARY OF DRILLING ACTIVITY IN CANADA, 1999

Drilling Activity	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal
	Off-Mine-Site		On-Mine-Site		Off-Mine-Site		On-Mine-Site		On- Plus Off-Mine-Site
	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)
Diamond drilling									
Surface	1 229 513	97.1	142 069	33.3	186 672	63.0	36 537	12.7	1 594 791
Underground	36 841	2.9	284 893	66.7	109 600	37.0	250 645	87.3	681 979
Subtotal	1 266 354	100.0	426 962	100.0	296 272	100.0	287 182	100.0	2 276 770
Percentage of off- plus on-mine-site diamond drilling	74.8		25.2		50.8		49.2		
Other drilling									
Surface	42 945	100.0	9 251	49.1	91 191	100.0	35 958	100.0	179 345
Underground	–	0.0	9 603	50.9	–	0.0	–	0.0	9 603
Subtotal	42 945	100.0	18 854	100.0	91 191	100.0	35 958	100.0	188 948
Percentage of other drilling for off- plus on-mine-site	69.5		30.5		71.7		28.3		
Total	1 309 299		445 816		387 463		323 140		2 465 718

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 11a. EXPLORATION PLUS DEPOSIT APPRAISAL, SURFACE DRILLING,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					(000 metres)				
Newfoundland	53	34	–	–	18	17	–	–	122
Nova Scotia	. . .	3	1	–	1	11	–	–	17
New Brunswick	45	20	–	–	–	3	–	–	68
Quebec	153	491	50	–	2	6	1	–	704
Ontario	89	145	–	–	2	2	8	–	245
Manitoba	71	7	–	–	1	–	–	–	79
Saskatchewan	36	12	. . .	62	1	–	1	–	112
Alberta	–	1	–	–	. . .	–	7	135	144
British Columbia	26	45	–	–	1	4	–	5	81
Yukon	3	11	–	–	–	–	–	2	15
Northwest Territories	3	3	–	–	1	–	103	–	110
Nunavut	18	44	–	1	1	–	13	–	77
Total	496	817	51	63	28	44	133	142	1 774

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
[1] Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.
Note: Numbers may not add to totals due to rounding.

TABLE 11b. EXPLORATION PLUS DEPOSIT APPRAISAL, UNDERGROUND DRILLING,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
	(000 metres)								
Newfoundland	–	–	–	–	–	–	–	–	–
Nova Scotia	–	–	–	–	–	–	–	–	–
New Brunswick	10	6	–	–	–	–	–	–	17
Quebec	45	151	–	–	–	8	–	–	204
Ontario	80	317	–	–	7	–	–	–	404
Manitoba	31	–	–	–	–	–	–	–	31
Saskatchewan	. . .	–	–	1	–	–	–	–	1
Alberta	–	–	–	–	–	–	–	–	–
British Columbia	4	25	–	–	–	3	–	–	31
Yukon	–	–	–	–	–	–	–	–	–
Northwest Territories	–	–	–	–	–	–	–	–	–
Nunavut	2	1	–	–	–	–	–	–	3
Total	173	500	–	1	7	11	–	–	692

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
[1] Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.
Note: Numbers may not add to totals due to rounding.

TABLE 12. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY MINERAL COMMODITY SOUGHT, 1999

Mineral Commodity	1998 Expenditures	1999 as % of 1998 Expenditures	1999 Expenditures			Percentage of Canadian Total
			On-Mine-Site	Off-Mine-Site	On-Mine-Site Plus Off-Mine-Site	
	($ millions)	(%)		($ millions)		(%)
Base metals[2]	192.1	72.5	23.7	115.7	139.3	27.6
Precious metals[3]	243.0	74.5	60.8	120.2	181.0	35.9
Iron ore	0.1	3 167.1	–	4.4	4.4	0.9
Uranium	51.5	68.3	–	35.2	35.2	7.0
Other metals	23.7	65.6	0.7	14.8	15.5	3.1
Nonmetals	12.8	93.3	0.8	11.1	12.0	2.4
Diamonds	119.1	91.3	–	108.7	108.7	21.6
Coal	13.2	62.4	0.8	7.4	8.2	1.6
Unspecified mineral commodities	0.4	–	–	–	–	–
Total	655.9	76.9	86.8	417.6	504.3	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
- Nil.
[1] Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs. [2] Includes copper, nickel, lead and zinc. [3] Includes silver, gold and platinum group metals.
Note: Numbers may not add to totals due to rounding.

TABLE 13a. EXPLORATION EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
	($000)								
Newfoundland	12 717	4 677	11	–	3 841	677	27	–	21 950
Nova Scotia	187	290	167	–	360	2 803	–	5	3 812
New Brunswick	5 713	2 467	–	–	–	233	–	–	8 413
Quebec	34 000	35 486	4 000	314	1 500	1 702	1 220	–	78 222
Ontario	20 915	37 343	15	–	961	286	7 756	–	67 277
Manitoba	16 424	1 879	–	–	675	16	410	–	19 404
Saskatchewan	1 659	1 695	157	13 451	157	–	858	113	18 090
Alberta	8	605	–	–	160	2	7 813	2 264	10 850
British Columbia	7 029	12 114	–	–	215	438	–	1 301	21 097
Yukon	2 365	8 708	–	–	115	96	–	449	11 734
Northwest Territories	1 490	1 765	–	192	232	–	24 206	–	27 885
Nunavut	7 970	7 580	–	435	282	–	9 658	–	25 926
Total	110 476	114 610	4 350	14 392	8 499	6 253	51 948	4 132	314 660

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 13b. DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland	5 351	8	13	–	2 675	1 309	–	–	9 355
Nova Scotia	201	105	39	–	143	959	–	–	1 446
New Brunswick	1 020	680	–	–	–	–	–	–	1 700
Quebec	5 135	26 128	–	–	2 596	1 486	–	–	35 325
Ontario	3 305	15 494	–	–	1 103	214	–	–	20 117
Manitoba	3 292	69	–	–	32	50	–	–	3 443
Saskatchewan	4 617	–	–	20 800	–	66	–	–	25 483
Alberta	–	–	–	–	–	13	–	3 875	3 888
British Columbia	5 209	13 126	–	–	35	1 641	–	201	20 213
Yukon	348	661	–	–	–	–	–	–	1 010
Northwest Territories	96	232	–	–	443	–	55 466	–	56 237
Nunavut	277	9 873	–	–	–	–	1 321	–	11 471
Total	28 851	66 376	52	20 800	7 027	5 718	56 787	4 075	189 688

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 13c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland	18 067	4 685	24	–	6 516	1 986	27	–	31 305
Nova Scotia	387	395	206	–	503	3 761	–	5	5 258
New Brunswick	6 733	3 147	–	–	–	233	–	–	10 113
Quebec	39 135	61 614	4 000	314	4 096	3 168	1 220	–	113 547
Ontario	24 221	52 837	15	–	2 064	500	7 756	–	87 393
Manitoba	19 716	1 948	–	–	707	66	410	–	22 847
Saskatchewan	6 276	1 695	157	34 251	157	66	858	113	43 573
Alberta	8	605	–	–	160	15	7 813	6 139	14 739
British Columbia	12 238	25 240	–	–	250	2 080	–	1 502	41 310
Yukon	2 714	9 370	–	–	115	96	–	449	12 744
Northwest Territories	1 586	1 998	–	192	674	–	79 672	–	84 123
Nunavut	8 247	17 453	–	435	282	–	10 979	–	37 397
Total	139 328	180 986	4 401	35 193	15 526	11 971	108 735	8 208	504 348

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 13d. MINE DEVELOPMENT EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 1999

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland	–	1 470	7 510	–	–	447	–	–	9 427
Nova Scotia	–	–	–	–	–	2 650	–	3 659	6 309
New Brunswick	23 238	14 763	–	–	–	2 777	–	–	40 778
Quebec	118 213	86 323	93 484	–	14 761	47 535	–	–	360 316
Ontario	66 186	153 324	–	–	2 488	3 438	–	–	225 434
Manitoba	33 684	7 817	–	–	233	116	–	–	41 850
Saskatchewan	4 863	4 000	–	75 084	–	4 275	–	346	88 568
Alberta	–	–	–	–	17	639	–	31 188	31 845
British Columbia	1 951	1 104	–	–	4 188	703	–	32 534	40 479
Yukon	17	33	–	–	–	–	–	–	50
Northwest Territories	–	8 072	–	–	–	–	230	–	8 302
Nunavut	615	186	–	–	–	–	–	–	801
Total	248 765	277 092	100 994	75 084	21 687	62 580	230	67 726	854 160

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.

[1] Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 14a. EXPLORATION EXPENDITURES,[1] BY TYPE OF COMPANY AND MINERAL COMMODITY, 1999

Type of Company	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
1. Companies with a producing mine in Canada	59 178	58 373	4 000	10 896	1 259	1 883	7 799	3 672	147 060
2. Affiliates of group 1	14 509	5 878	–	–	3 258	–	10 198	–	33 844
3. Oil companies	222	652	–	–	–	–	–	–	874
4. Foreign companies (excluding group 3)	3 057	3 163	–	–	–	–	19 738	–	25 958
5. Junior companies and prospectors	29 514	40 139	298	3 343	3 883	4 151	10 892	460	92 680
6. Other companies	3 996	6 404	51	153	99	220	3 321	–	14 245
Total all classes	110 476	114 610	4 350	14 392	8 499	6 253	51 948	4 132	314 660

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 14b. DEPOSIT APPRAISAL EXPENDITURES,[1] BY TYPE OF COMPANY AND MINERAL COMMODITY, 1999

Type of Company	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
1. Companies with a producing mine in Canada	10 540	43 984	–	–	756	566	–	3 875	59 721
2. Affiliates of group 1	6 921	155	–	20 800	2 675	–	23 842	–	54 394
3. Oil companies	–	–	–	–	–	–	–	191	191
4. Foreign companies (excluding group 3)	1 075	7 349	–	–	–	147	16 450	–	25 021
5. Junior companies and prospectors	10 301	14 558	52	–	3 018	4 064	16 495	10	48 498
6. Other companies	15	330	–	–	578	941	–	–	1 863
Total all classes	28 851	66 376	52	20 800	7 027	5 718	56 787	4 076	189 688

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 14c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY TYPE OF COMPANY AND MINERAL COMMODITY, 1999

Type of Company	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
1. Companies with a producing mine in Canada	69 718	102 357	4 000	10 896	2 014	2 449	7 799	7 547	206 781
2. Affiliates of group 1	21 430	6 033	–	20 800	5 933	–	34 040	–	88 237
3. Oil companies	222	652	–	–	–	–	–	191	1 065
4. Foreign companies (excluding group 3)	4 131	10 512	–	–	–	147	36 188	–	50 979
5. Junior companies and prospectors	39 815	54 697	350	3 343	6 901	8 215	27 387	470	141 177
6. Other companies	4 011	6 734	51	153	677	1 160	3 321	–	16 108
Total all classes	139 328	180 986	4 401	35 193	15 526	11 971	108 735	8 208	504 348

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 15a. EXPLORATION EXPENDITURES[1] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 1999

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	Total
				($000)			
Newfoundland	1 026	11 861	–	548	8 415	100	21 950
Nova Scotia	126	–	–	–	3 520	166	3 812
New Brunswick	6 983	–	–	5	1 400	25	8 413
Quebec	42 483	486	25	942	25 757	8 529	78 222
Ontario	43 484	1 644	20	8 897	12 604	628	67 277
Manitoba	12 416	3 266	–	125	2 490	1 108	19 404
Saskatchewan	11 238	889	–	843	4 744	397	18 090
Alberta	2 258	971	–	5 476	1 914	233	10 850
British Columbia	10 603	2 252	–	309	7 934	–	21 097
Yukon	1 130	2 513	–	416	7 672	3	11 734
Northwest Territories	7 741	6 107	–	3 977	7 024	3 037	27 885
Nunavut	7 571	3 876	829	4 422	9 208	20	25 926
Total	147 060	33 844	874	25 958	92 680	14 245	314 660

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 15b. DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 1999

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	Total
				($000)			
Newfoundland	137	8 026	–	30	1 163	–	9 355
Nova Scotia	–	–	–	–	1 446	–	1 446
New Brunswick	1 700	–	–	–	–	–	1 700
Quebec	30 844	–	–	1 011	1 969	1 501	35 325
Ontario	16 575	155	–	1 117	1 955	315	20 117
Manitoba	1 706	1 571	–	–	166	–	3 443
Saskatchewan	18	20 800	–	–	4 665	–	25 483
Alberta	3 888	–	–	–	–	–	3 888
British Columbia	3 734	–	191	–	16 270	18	20 213
Yukon	377	–	–	–	632	–	1 010
Northwest Territories	405	23 842	–	16 450	15 510	30	56 237
Nunavut	337	–	–	6 413	4 721	–	11 471
Total	59 721	54 394	191	25 021	48 498	1 863	189 688

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 15c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 1999

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	Total
				($000)			
Newfoundland	1 163	19 887	–	578	9 577	100	31 305
Nova Scotia	126	–	–	–	4 966	166	5 258
New Brunswick	8 683	–	–	5	1 400	25	10 113
Quebec	73 328	486	25	1 953	27 726	10 030	113 547
Ontario	60 059	1 799	20	10 014	14 560	943	87 393
Manitoba	14 122	4 836	–	125	2 656	1 108	22 847
Saskatchewan	11 256	21 669	–	843	9 409	397	43 573
Alberta	6 146	971	–	5 476	1 914	233	14 739
British Columbia	14 337	2 252	191	309	24 204	18	41 310
Yukon	1 508	2 513	–	416	8 304	3	12 744
Northwest Territories	8 146	29 949	–	20 427	22 534	3 067	84 123
Nunavut	7 907	3 876	829	10 835	13 930	20	37 397
Total	206 781	88 237	1 065	50 979	141 177	16 108	504 348

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 16. GENERALIZED MODEL OF THE MINERAL RESOURCE DEVELOPMENT AND MINING PROCESS

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRONMENTAL RESTORATION
		GRASSROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine development, construction of processing plant and infrastructure.	Production, marketing and renewal of reserves.	Mine complex closure and decommissioning, site restoration.
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest", to justify more intensive and detailed work.	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically.	Obtain all the information required and determine, based on corporate objectives, parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustainable development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new targets.	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Pre-feasibility studies.	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Pre-feasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommissioning. Environmental restoration and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%; mining: ± 5%)		Full compliance
INVESTMENTS	Moderate	Low, but increasing multiple investments.						Larger and increasing multiple investments.			Very large industrial investment.		
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss.						High, but decreasing risk of failure.			Moderate to low industrial risk.		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

Canadian Mineral Exploration and Discovery Analysis

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CANADA'S STANDING AS AN EXPLORATION TARGET

In 1999, exploration and deposit appraisal expenditures for non-petroleum minerals in Canada totaled $504.3 million. Canada remained one of the world's top exploration targets (second after Australia) in terms of mineral exploration expenditures that year. Exploration and deposit appraisal for 2000 totaled $473 million (a preliminary total gathered early in 2000). The decline in exploration expenditures in Canada is typical of the decline in exploration expenditures worldwide. The Metals Economics Group's (MEG) survey[1] (data gathered later in 2000) indicates that the United States continued to hold third position in 2000. The relative rankings of these top three countries have remained unchanged since 1992 (Figure 1). Although the MEG study is the only one to look at exploration spending worldwide, it does not adequately account for exploration expenditures in countries such as China and the various countries that have resulted from the breakup of the former Soviet Union. This is because MEG surveys only exploration expenditures by the "Western" companies exploring in these countries, so its survey results are indicative of only part of the exploration there. The value of China's mineral production is at least six times that of Canada, at least five times that of Australia, and more than 50% higher than that of the United States (Table 1). For this reason, it is likely that the magnitude of China's mineral exploration effort actually exceeds that in any of Australia, Canada or the United States. The MEG survey, which is conducted yearly, underwent a major change in its methodology in the 2000 edition. The

Figure 1
Top Three Country Destinations of Mineral Exploration Capital from Worldwide Sources, 1975-2000

Year	Rank		
	First	Second	Third
2000	Australia	**Canada**	United States
1999	Australia	**Canada**	United States
1998	Australia	**Canada**	United States
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States
1979	Australia	United States	**Canada**
1978	Australia	United States	**Canada**
1977	United States	**Canada**	Australia
1976	**Canada**	United States	Australia
1975	United States	**Canada**	Australia

Source: Natural Resources Canada, based on official Canadian and Australian statistics and the best available data for the United States.
Notes: Australian expenditures were 6.5% higher than those for Canada in 1983 and 3.3% higher in 1991; however, correcting the reported Australian totals for substantial mine development expenditures, which are not included in Canadian statistics, ranks Canada first in 1983 and 1991. Complete data are not available for the former Soviet Union and China.

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[1] *Corporate Exploration Strategies*, published by Metals Economics Group, Halifax, Nova Scotia, September 2000.

exploration budget cutoff was reduced from US$2.9 million in 1999 to US$100 000 in 2000. This cutoff reduction should have largely corrected the previous consistent substantial underestimation by MEG of the real levels of annual exploration spending in Canada and Australia that had resulted from the omission of the exploration expenditures of several hundred active companies in these countries.

RECENT MINERAL EXPLORATION AND DISCOVERY ACTIVITY AND RESULTS ACROSS CANADA

Some Canadian exploration highlights in 2000 include:

In Newfoundland, Thundermin Resources Inc. and Queenston Mining Inc. drilled the Duck Pond and Boundary Pond deposits, originally discovered in 1987. Resources at Duck Pond are 6.2 Mt grading 3.4% copper, 6.2% zinc, 1.0% lead, 63 g/t silver and 0.8 g/t gold. The deposits are under option from Noranda Inc. Metallurgical tests have been carried out and a recently completed feasibility study indicates that the project is economically viable.

In Quebec, Noranda Inc. discovered the Perseverance zinc deposit (5 Mt grading 16.8% zinc, 1.3% copper, 34 g/t silver and 0.4 g/ gold, in three deposits) near its mining operation at Matagami. Perseverance will add seven years to the life of the Matagami operation. On the Raglan nickel-copper property, Falconbridge Limited discovered a new ore lens at the West Boundary Zone, 15 km east of the concentrator, the eighth deposit discovered by Falconbridge on the property since 1995.

At Sudbury, Ontario, where more than 10 nickel-copper deposits have been found since 1990, Inco Limited announced the discovery of a new deposit at Pump Lake. Drilling has indicated 3.5 Mt grading 1.5% nickel, 1.0% copper and 1.5 g/t combined platinum-palladium-gold with ongoing drilling expected to increase this resource.

Exploration by North American Palladium Ltd. continues to increase ore reserves at the Lac des Iles mine in northwestern Ontario where mill capacity has recently been increased from 2400 t/d to 15 000 t/d. At the end of 2000, measured and indicated resources had increased to 145.7 Mt grading 1.57 g/t palladium, 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel with a further 19.7 Mt classified as inferred. This tonnage contains 8.4 million troy oz of palladium. The orebody remains open to the east, west and at depth. Further increases in reserves and resources are expected.

Metallurgical work and a pre-feasibility study on the Big Whopper pegmatite deposit of Avalon Ventures Ltd., discovered northwest of Kenora, Ontario, in 1997, which contains 13.8 Mt grading 1.34% Li_2O and 0.30% Rb_2O and is open at depth, indicate that selective flotation can recover more than 90% of the petalite in a concentrate with an average grade of 4.4% Li_2O and an exceptionally low iron content (less than 0.02% Fe_2O_3). In addition to petalite, the flowsheet also provides for the recovery of separate concentrates of rubidium-potassium-feldspar, albite, spodumene, mica, tantalum and tin. The pre-feasibility study indicated that the project (mineable by open pit) will yield a discounted cash flow rate of return of 39.5%. The company plans to proceed with a full feasibility study at a cost of $5.0 million. The "Big Whopper" is one of only four such large petalite-pegmatite deposits in the world. Drilling is in progress on a separate tantalum-bearing lepidolite dyke on the property.

An initial 300-t bulk sample taken by De Beers Canada Exploration Inc. from the Victor kimberlite, located to the west of James Bay in Ontario, yielded diamonds valued at US$154/ct, with a kimberlite value of US$50/t.

In Manitoba, kimberlite indicator mineral dispersal trains have been found by provincial geological survey geologists in the Superior province (of Archean age), in the northeastern part of Manitoba to the north and south of Knee Lake, and near the Echimamish River. This has led to the acquisition of 60 to 70 exploration permits by more than 20 companies, including De Beers and BHP Diamonds Inc. The permits covered an area of 31 000 km^2 as of mid-April 2001. Detailed exploration, including drilling, is under way on some of these permit areas.

In Saskatchewan, one year after commencement of production at the McArthur River mine, Cameco Corporation announced that proven and probable reserves at the mine, the world's largest and highest grade uranium mine, have been increased by more than 50% to 394.5 million lb of U_3O_8 in ore grading an average 21.18% U_3O_8. The increase is based on drilling done during 1999-2000 together with results of the initial year of production. Cameco continued to drill a property at La Rocque Lake where high-grade uranium intersections were first reported in 1999. Results of this work have not yet been released.

Exploration of Foran Mining Corporation's McIlvena Bay zinc-copper deposit continues. Indicated and inferred resources for this deposit now stand at 14.5 Mt grading 0.91% copper, 6.08% zinc, 0.40% lead, 0.45 g/t gold and 23.70 g/t silver, plus another 12.1 Mt grading 1.81% copper, 0.54% zinc, 0.63 g/t gold and 12.47 g/t silver. The deposit is open down-plunge and to the northeast.

Diamonds continue to be the principal exploration target in the Northwest Territories, which is expected to produce diamonds at a rate of $1.5 billion annually by 2004 (see Diamond Exploration Highlights below for additional information).

In Nunavut, the Naartok gold deposit was discovered on the Hope Bay gold property, bringing the number of known gold deposits on that property to four. A $10 million exploration program is being carried out on the Hope Bay property where more than $85 million has been spent on exploration to date. At the Meadowbank gold project, to the north of Baker Lake, the Vault gold deposit was discovered, the fifth deposit to be discovered and outlined on that property in five years.

DIAMOND EXPLORATION HIGHLIGHTS

Exploration for diamonds continues at a substantial number of properties in Labrador, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, the Northwest Territories and Nunavut (Figure 2). This chapter only describes properties that have been demonstrated to have diamond contents and values that appear to have promising economic potential.

Ekati Diamond Mine, Northwest Territories

Diamond exploration of the Ekati mine property continues to result in the discovery of additional diamond-bearing kimberlite pipes. During the summer of 2000, 11 additional pipes were discovered for a total of 136 pipes confirmed on the property at year-end. Ninety-seven of these pipes are in the core zone claim block, and thirty-nine are in the outlying buffer zone. Exploration is ongoing.

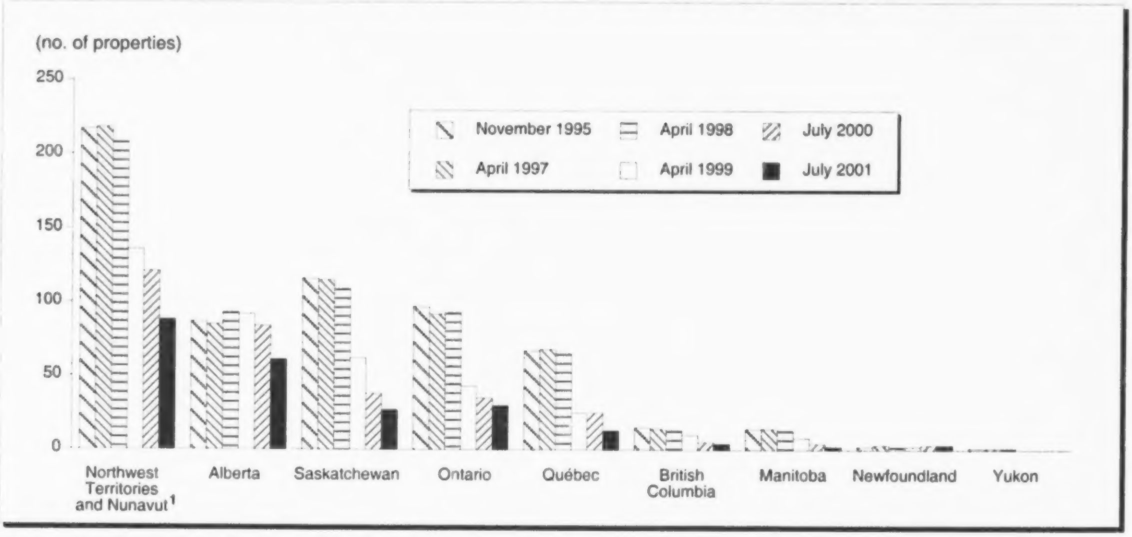
In addition to the previously approved mining plans for the Panda, Misery, Koala, Fox and Sable pipes, the mine plan has been amended to include the Koala North, Pigeon and Beartooth pipes.

The Pigeon pipe has a surface area of about 2 ha and is reported to contain a kimberlite ore reserve of 5.3 Mt to a depth of 200 m, at a waste-to-ore stripping ratio of 9.7 to 1. The Beartooth pipe has a surface area of 1 ha, with reserves of 1.4 Mt to a depth of 155 m, at a 12-to-1 stripping ratio.

Results from drill samples collected early in 2000 are as follows:

Pipe	Dry Tonnes	Total Carats Recovered	Average Grade
		(>1 mm)	(ct/t)
Wolverine	130.8	8.59	0.07
Zach	63.3	11.30	0.18
Cougar	74.3	0.72	0.01
Lynx	168.5	140.74	0.83

Figure 2
Regional Distribution of Diamond Exploration and Deposit Appraisal Properties, 1995-2001



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1995-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

[1] In July 2001 (2000), there were 78 (112) diamond exploration properties in the Northwest Territories and 10 (9) in Nunavut, for a total of 88 (121) properties in the two territories.

Diamond valuations were not carried out on the diamonds from the Wolverine, Zach and Cougar pipes because of the low diamond recoveries.

The diamonds from the Lynx pipe have been valued at US$139/ct. An additional bulk sample from the Lynx pipe, weighing approximately 150 t, was taken during the first quarter of 2001.

The kimberlites discovered during the summer of 2000 include the following:

Pipe	Sample weight	Total Carats Recovered	Grade
	(kg)	(>1 mm)	(ct/t)
Kodiak	81.7	0.87	10.6
Pegasus	29.1	0.33	1.1
Wildebeest	35.0	0.032	0.9

Diavik Project, Northwest Territories

On December 19, 2000, the final decision was made to develop the Diavik diamond mining project. Construction is in progress at an estimated total cost of $1.3 billion. Initial production is expected in the first half of 2003. The Diavik project plan calls for a two-year production ramp-up period after which 1.5 Mt of kimberlite are expected to be processed annually. Diamond production is anticipated to average approximately 6 Mct/y. The Diavik mine will yield a total of 101.5 Mct of diamonds at an average value of US$63/ct over a 20-year mine life.

Exploration of the Diavik property continued in 2000.

Snap Lake Project, Northwest Territories

De Beers has acquired the Snap Lake diamond deposit at a cost of $379 million by taking over Winspear Diamonds Inc. (67.76% owner of the deposit) and purchasing the 32.24% interest that was owned by Aber Diamond Corporation. Indicated ore reserves are 22.8 Mt at a mineable grade of 1.65 ct/t. A further 20 Mt are classified as inferred. The diamond value is about US$100/ct. De Beers continues exploration and bulk sampling of the Snap Lake deposit. Exploration and economic studies confirm that the site will support a 3000-t/d underground mine. Phase one will employ up to 450 people during construction and 350 people during an anticipated mine life of over 20 years. De Beers estimates that production could begin early in 2004 provided that permits are issued allowing construction to begin at the end of 2002.

Jericho Property, Nunavut

Tahera Corporation has a feasibility study on the Jericho JD/OD1 kimberlite pipe. The study indicates that approximately 3.0 Mct of diamonds can be produced over an eight-year mine life. Open-pit mining would mine a cumulative 1.9 Mt of reserves for the first four years, to be followed by the mining of 614 000 t of reserves from underground, from a decline. Additional diamondiferous kimberlite resources may be converted to reserves, which could extend the life of the mine beyond eight years.

Tahera continues to explore for kimberlite pipes in the Jericho area and is attempting to obtain financing for the proposed diamond mine. Estimated resources for the JD/OD1 kimberlite are as follows:

Indicated Resources	Tonnage	Recovered Grade	Recovered Carats	Value
	(Mt)	(ct/t)	(000s)	(US$/t)
North - Upper Lobe	0.603	0.77	467	46.20
North - Lower Lobe	0.908	0.71	647	42.60
Central Lobe	2.156	1.42	3 062	109.34
Total indicated	3.667	1.14	4 176	82.50
Inferred resources	3.401	0.52	1 757	31.54
Total resources	7.068	0.84	5 933	57.98

Victor Kimberlite, Ontario

De Beers has discovered 18 kimberlite pipes on its property in the James Bay Lowlands, some 90 km west of Attawapiskat, Ontario. Sixteen of these kimberlites are diamondiferous. The site was originally discovered in 1980, but it was not until 1999 that encouraging results were obtained from the Victor kimberlite. A bulk sample of approximately 7000 t was extracted from the Victor kimberlite (the largest of the 18 pipes with an area of approximately 15 ha) in early 2000 using a 24-inch-diameter reverse circulation drill to a depth of 200 m below surface, and from two near-surface trenches. The drill program was to be carried over into the winter of 2000/01. Results of an initial 300-t bulk sample, released by De Beers, yielded diamonds valued at US$154/ct for a kimberlite value of US$50/t. Results for the larger bulk sample have not yet been released.

De Beers reports that the results of the bulk sampling program, and of the evaluation of the diamonds recovered, are expected to be available in late 2001 or early 2002 and will be used to determine whether the site will advance to a full mine feasibility study. A team of De Beers' mining engineers is currently working on a desktop study.

Gahcho Kué Project, Northwest Territories

This project, formerly known as the AK claims, and later as the Kennady Lake property, is a joint venture between De Beers Canada Exploration Inc. (51%), Mountain Province Diamonds Inc. (44.1%) and Camphor Ventures Inc. (4.9%). De Beers has the right to earn up to a 60% interest in the AK and CJ properties by taking the project to commercial production. De Beers indicates that the intention of a drilling project during the winter of 2000/01 was to determine whether it is possible to increase diamond revenues for the site by the approximately 15% that is needed to move the project to the feasibility stage. In this bulk sampling program, which cost $8 million to $10 million, De Beers plans to recover 1000-1250 ct from each of the Hearne and 5034 kimberlites. De Beers considers these kimberlites to be the most prospective of the kimberlites discovered thus far on the property and the pipes which, to date, have returned the highest values in terms of revenue per tonne.

De Beers recovered approximately 307 t from the Hearne pipe and 550 t from the 5034 pipe. Although fewer holes were drilled than had been planned because of unseasonably warm winter weather, the quantity of diamonds expected to be recovered is expected to be adequate for evaluation and modeling purposes.

De Beers is to carry out exploration drilling on other parts of the AK claims during the summer of 2001 with the drilling targets to be based on geophysical targets and indicator mineral sampling.

Buffalo Hills Property, Alberta

In March 2000, Ashton Mining of Canada Inc. discovered the K252 kimberlite. The area of this kimberlite is approximately 2 ha. A 1.28-t sample of volcaniclastic kimberlite yielded 0.85 ct of diamonds larger than 0.8 mm, using a square aperture screen, or 0.66 ct/t. The largest diamond was a colourless composite crystal weighing 0.36 ct. This is the most encouraging of the 35 kimberlites discovered on the Buffalo Hills property to the end of 2000. In March 2001, Ashton took a 22.8-t mini-bulk sample from the K252 kimberlite that yielded 12.54 ct of diamonds larger than 0.8 mm in size, or 0.55 ct/t. If the 4.0 t of mudstone from intervals in the kimberlite breccia are included, the 26.8 t of material recovered have a combined grade of 0.47 ct/t. The largest diamond recovered was a 0.94-ct composite crystal while the second largest was a colourless 0.65-ct stone. The next six diamonds have weights that range from 0.17 to 0.28 ct.

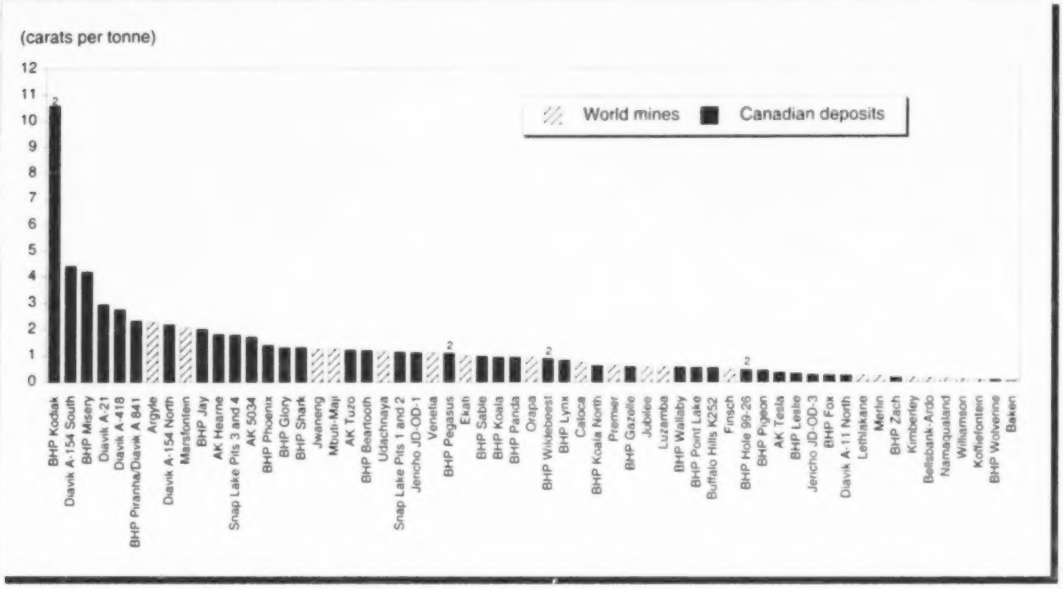
Ashton plans a program of geotechnical studies and financial analysis to identify preliminary economic thresholds for diamond content and value. The company states that this would be followed by delineation drilling and the collection of a larger sample.

Notes: (1) Information in this review was current as of May 31, 2001. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

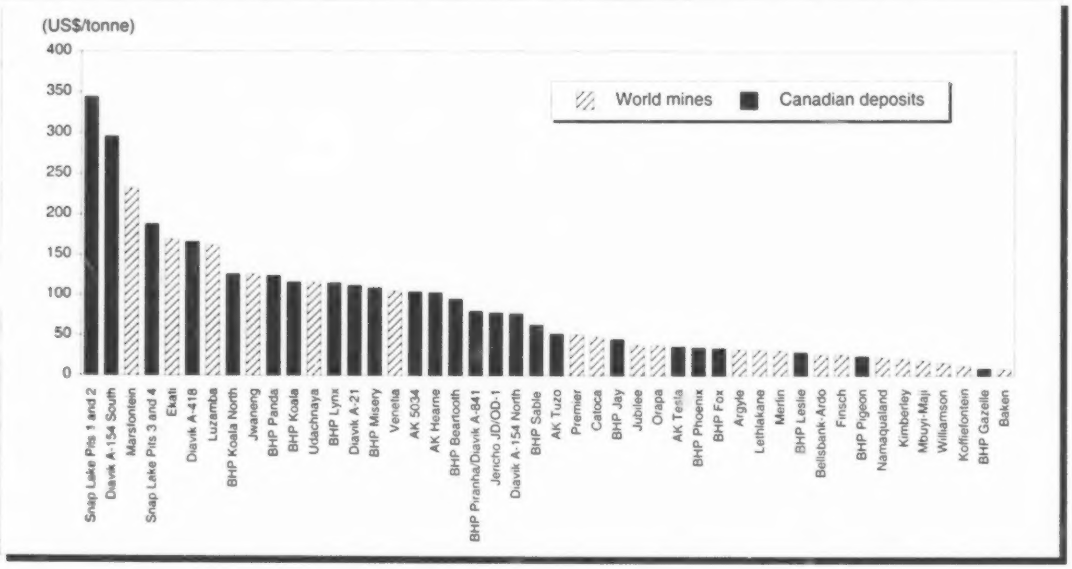
Figure 3
Recoverable Diamond Grades From World Diamond Mines[1] and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

[1] Grades of world diamond mines are 1999 production grades. [2] Based on a sample weight of a fraction of a tonne of drill core.

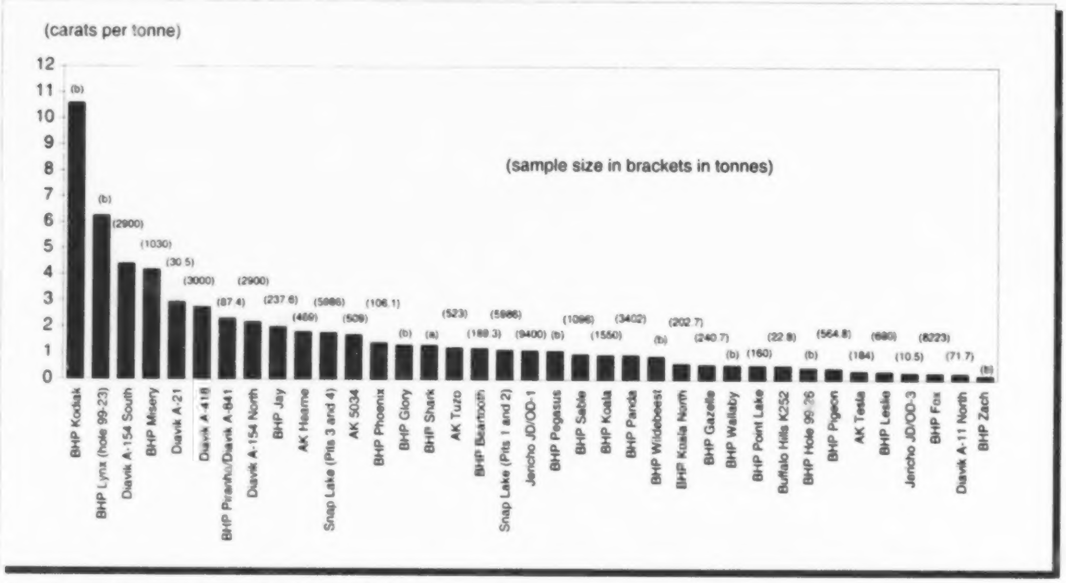
Figure 4
Recoverable Diamond Values for World Diamond Mines[1] and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

[1] Values for world diamond mines are 1999 production grades.

Figure 5
Grades of Selected Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.
(a) Sample size not available. (b) Based on samples of only a fraction of a tonne of drill core.

TABLE 1. THE WORLD'S TOP 25 MINERAL PRODUCERS IN 1996

Rank	Country	Production Value
		(US$ billions)
1	China	78.7ª
2	United States	58.6
3	South Africa	18.0
4	Australia	16.9
5	Russia	16.5ª
6	**Canada**	14.6
7	India	14.5
8	Brazil	9.9
9	Germany	9.4
10	Japan	9.2
11	Chile	9.2
12	Mexico	7.0
13	Poland	6.7
14	Indonesia	6.1
15	South Korea	5.3
16	Italy	5.2
17	Peru	4.8
18	United Kingdom	4.5
19	Spain	4.4
20	Turkey	4.2
21	Kazakhstan	3.5
22	Iran	3.2
23	Ukraine	3.2
24	France	3.2
25	North Korea	2.5

Source: Natural Resources Canada (compiled by author).
ª Totals for China and Russia exclude most construction minerals.

TABLE 2. SELECTED DATA ON CANADA'S MOST PROMISING DIAMOND DEPOSITS

Pipe	Total Tonnes Sampled	Total Carats Recovered	Average Grade (ct/t)	Average Value (US$/ct)	Average Value (US$/t)
EKATI MINE AND BUFFER ZONE PROPERTIES					
Panda	3 402	3 244	0.95	130	124
Misery	1 030	4 313	4.19	26	109
Koala	1 550	1 465	0.95	122	116
Koala North	201.7	126.58	0.63	200[a]	126
Fox	8 223	2 199	0.27	125	34
Leslie	680	233	0.33	89	29
Pigeon (original sample)	154	60	0.39	51	20
Pigeon (1998 sample)	564.8	251.31	0.45	54	24
Jay	237.6	476.8	2.01	22.50	45
Sable	1 096	1 070	0.98	64	63
Beartooth	189.3	227.09	1.20	79	95
Point Lake	160	90+	0.56	. .	. .
Phoenix (98-C)	106.1	149.2	1.41	25	35
Shark	. .	. .	1.32	. .	. .
Gazelle	240.7	141.4	0.59	15	9
Glory	0.2438	. .	1.32	. .	. .
Wallaby	0.1208	. .	0.57	. .	. .
Piranha (= A841) (straddles boundary of Buffer claims and Diavik property)	87.4	203.44	2.33	30	80
Lynx	168.5	140.74	0.83	139	115
Hole 99-26	0.1736	0.082	0.47	. .	. .
Wolverine	130.8	8.59	0.07	. .	. .
Zach	63.3	11.30	0.18	. .	. .
Kodiak	.0817	0.87	10.6	. .	. .
Pegasus	.291	0.33	1.1	. .	. .
Wildebeest	.0350	0.032	0.9	. .	. .
DIAVIK PROPERTY					
A-154 South	2 900	12 800	4.41	67	296
A-154 North	71.72	156.81	2.19	35	77
A-418	3 000	8 275	2.76	56	166
A-21	30.5	90	2.95	38	112
A-11 North	29	7.6	0.26	. .	. .
JERICHO PROPERTY					
JD/OD-1	9 400	10 539	1.12	70[c]	78[c]
JD/OD-3 (first sample)	10.53	7.34	0.697[b]	. .	. .
JD/OD-3 (second sample)	35.9	10.41	0.29	. .	. .
AK PROPERTY					
5034 (1999 bulk sample)	609	1044	1.71	63	104
Hearne	469	856	1.82	44	103
Tuzo	469	540	1.03	43	52
Tesla	. .	. .	0.37	96	36
Tesla (1999 bulk sample)	184	64	0.35	. .	. .
SNAP LAKE PROPERTY					
Snap Lake Dike (Pits 1 and 2)	199.7	226.7	1.14	301	344
Snap Lake Dike (Pits 3 and 4)	5 985.7	10 708.1	1.789	105	188
BUFFALO HILLS PROPERTY					
K252 (kimberlite only)	22.8	12.54	0.55	. .	. .
K252 (including mudstone)	26.8	12.60	0.47	. .	. .

Source: Natural Resources Canada, based on company data.

. . Not available.

[a] Approximately 77% of the value is due to three gem-quality stones 3.26 to 5.41 ct in size. [b] Includes a single 3.6-ct stone; if this stone is excluded, the grade is 0.25 ct/t. [c] Values have been revised to include stones larger than 10.8 ct that had been omitted in previously published values.

Canadian Mine Openings, Closings, Expansions, Extensions and New Mine Developments in 2000

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OVERVIEW

In 2000, mining in Canada continued to suffer from the gold and base-metal price downturn that has been lingering since 1997. Although mines producing nickel, niobium, iron ore, platinum metals and diamonds faired reasonably well, most other metal and nonmetal mines were struggling to stay afloat while many failed to survive. During the year, mine closings continued to outpace mine openings as six mines opened (including two new mines and four re-openings) and twelve mines closed (including five closures and seven production suspensions) (Tables 1 and 2). Of the two new mines that came into production, one was a magnesium operation and the other a zinc mine. In addition, four gold mines re-opened. The five permanent closures consisted of two gold, one base-metal and two coal mines, whereas the seven production suspensions included three gold, one base-metal, one coal and two industrial mineral mines. Two of the mine openings (one gold and one base-metal) were owned and operated by foreign companies.

The new mines opened in 2000 were the Magnola magnesium operation in Quebec and the Chisel North zinc mine in Manitoba. The Magnola operation is an innovative mining and processing operation in which asbestos tailings are being "mined" and magnesium metals are being recovered, not unlike gold tailings operations. In terms of value of expected production and employment, these two mines were important new mines in 2000. The mines re-opened during the year included the Francoeur mine in Quebec, the Red Lake mine in Ontario, the Giant mine in the Northwest Territories, and the Lupin mine in Nunavut, all gold mines.

The year 2000 marked the closure of four significant mines in Canada. In Quebec, the Gallen zinc mine closed in December and, in Manitoba, the Keystone gold mine closed in April, both due to ore depletion. In Alberta, the Gregg River coal mine closed in August, a victim of high costs, low coal prices and unfavourable geological conditions. In British Columbia, the Quintette coal mine also closed in August as a result of high costs, declining coal prices in recent years, and failure to renew a metallurgical coal contract with Japanese steelmakers. Quintette was one of the largest coal mines in Canada.

In addition to production suspensions and mine closures, production cutbacks continued at several mines in 2000, especially at gold, base-metal, coal and uranium mines, which created additional employment losses during the year. Job losses through production cutbacks amounted to more than 250 in 2000. Although this was an improvement when compared with the 900 job losses in this category in 1999, it continued to extend a trend that started in 1997 and that has negatively affected regional economies.

In an effort to cut costs, mining companies continued to consolidate mine operations or to enter into operation-sharing accords in 2000, notably at McWatters Mining Corporation's Sigma gold mine (a pre-expansion consolidation at the Sigma-Lamaque mining complex) in Quebec; at Homestake Canada Inc. and Teck Corporation's David Bell gold mine and Williams mill, Battle Mountain Gold Company's Holloway mine, and Barrick Gold Corporation's Holt-McDermott mill, all in Ontario; and at Miramar Mining Corporation's Con and Giant gold mines in the Northwest Territories. While cost-cutting measures continued at all mines, significant results were achieved at several gold and base-metal mines, such as the Francoeur gold mine in Quebec, the Garson nickel-copper mine and the Red Lake gold mine in Ontario, and the Kemess South gold mine in British Columbia.

Despite widespread mine closings and production cutbacks at some mines, there were at least 11 significant mine expansion and extension projects across Canada (Table 2). Although half of these projects were the continuation of existing programs that began in recent years, half were new capital expansion projects. Important expansion programs that continued in 2000 were the Carol Lake iron ore operation in Labrador; the Doyon Division gold mines, the LaRonde gold-zinc-copper-silver mine and the Niobec niobium mine in Quebec; and the Creighton nickel-copper mine and the Lac des Iles palladium-platinum-gold-copper-nickel mine in Ontario. Five significant new expansion programs were announced or began in 2000. These were the Red Lake gold mine, the Kidd Creek zinc-copper-silver mine (Kidd Mining Division), and the McCreedy East and Stobie nickel-copper mines in Ontario, as well as the Birchtree nickel-copper mine in Manitoba.

The total capital cost for bringing new and re-opened mines into production in 2000 was estimated at about $1.1 billion compared with $850 million in 1999. Given the generally depressed mineral commodity prices and market conditions, this indicates that relatively high levels of capital investment, compared with exploration spending, have been maintained in Canada in recent years, reflecting the need for current producers to maintain or expand production capability through mine-site and new project developments, even during hard times. However, over 85% of this $1.1 billion capital cost was for the development of one single project – the world-class Magnola magnesium operation – indicating that capital investment in the traditionally strong areas of gold and base metals in Canada remained weak in the period 1999-2000. At least another $250 million is estimated to have been spent on mine expansions and extensions, similar to 1999. As no large mines are scheduled to come on stream until 2003, capital investment is expected to be lower in 2001.

REGIONAL PERSPECTIVE

During 2000, five provinces and two territories were affected by mine openings or closings. In terms of employment, ore capacity and production losses, Quebec suffered the most, followed by Alberta and British Columbia.

Quebec

In Quebec, two mines opened and five closed. The $920 million, 1000-t/d Magnola magnesium operation near Asbestos, Quebec, was brought on stream in September by Magnola Magnesium Inc., a subsidiary of Noranda Inc., creating 350 jobs. The operation, with a plant at Danville, recovers magnesium metal by processing material from a proven stockpile of some 57.6 Mt of serpentine asbestos tailings grading 23.1% magnesium. This is readily processible material from an estimated 250 Mt of asbestos (mostly serpentine) tailings accumulated over decades of asbestos mining near the town of Asbestos in the Eastern Townships. With a designed metal production capacity of 63 000 t/y, representing about 16% of global demand, Magnola is the largest magnesium operation in the world. Due to start-up problems that are in part associated with stringent environmental requirements, the operation is not expected to attain commercial production until late 2001 with full production in the second half of 2002. The 1125-t/d Francoeur gold mine near Rouyn-Noranda re-opened in February after more than four months of shut-down during which the mining method was changed to the long-hole method from the more expensive room-and-pillar method to trim production costs and to develop the newly discovered Zone 7. However, as its reserves are expected to be depleted by the fall of 2001, the mine is destined for permanent closure by then unless significant new ore can be discovered soon.

During 2000, the five mine closings consisted of four production suspensions and one closure. The 550-t/d Saint Onge (Orleans) mine near Lac St-Jean, the only wollastonite mine in Canada, closed in July as a result of high costs, a lingering weak market for wollastonite and the failure in finding a buyer for the mine. The 2350-t/d Gallen zinc mine near Rouyn-Noranda closed in December due to ore depletion. The mine was first brought on stream in November 1981 but production was suspended eight months later. Reactivated in 1984, production was once again suspended in 1985 until the mine's re-opening in October 1997. At a production rate of 50 000 t/y of zinc, the Gallen mine was a significant base-metal producer in Quebec. The 2500-t/d Langlois zinc-copper mine near Lebel-sur-Quévillon, another important base-metal producer in the province, suspended production in November due to problems with the main ore pass system, declining metal prices and high treatment charges. A long-term mine development and operating plan to increase production at lower costs is expected to be in place for re-opening the mine when metal prices are higher. Production at the 560-t/d Beaufor gold mine near Val-d'Or was suspended in August as a precautionary measure to assess the stability of some of the mine pillars. The 1350-t/d Joe Mann gold mine near Chibougamau, which was shut down in September 1999, re-opened in April 2000 and again suspended production in November due to low gold prices and the need to secure additional financing for mine development. Overall in 2000, Quebec suffered net losses of some 5200 t of daily ore capacity and about 220 direct mining jobs from mine openings and closings as the world-class Magnola operation was insufficient to offset the aggregate loss of five mines in the province. As four of the five mines closed in 2000 were gold and base-metal mines, the province continued to suffer from the decline of these two key segments of its mining industry, which started in 1999 when one base-metal and four gold mines were closed.

Ontario

In Ontario, one mine re-opened and two mines closed. The Red Lake gold mine at Balmertown resumed production in August after a four-year-long strike that began in June 1996. Prior to the strike, ore came primarily from the refractory ore reserves. Since the resumption of production, ore has come exclusively from the non-refractory High Grade Zone that was discovered during the shut-down. The significant size of this rich ore zone enabled the mine to be redeveloped into a world-class high-grade gold mine with a new capacity of 550 t/d. The mine was redeveloped at a capital cost of US$56 million. Commercial production was attained in January 2001. By June 2001, the company had forecast gold production for 2001 to be 440 000 oz at a cash cost of US$70/oz, making the Red Lake mine the largest and lowest-cost gold mine in Canada and one of the lowest-cost gold mines in the world. As of December 31, 2000, mineral reserves at the High Grade Zone stood at 1.633 Mt grading 57.6 g/t gold (1.68 oz/ton gold), or 3 million oz. In addition, the mine hosts another 1.633 Mt of refractory sulphide material grading 12.685 g/t (0.37 oz/ton) gold, which had been the source of ore for the past 48 years until the strike halted mine production in 1996. Due to persistently low gold prices, production was suspended at the 1300-t/d Stock mine in Stock Township in November. The 350-t/d Hislop West open-pit gold mine near Matheson closed in the same month due to the depletion of ore reserves. Overall, the province encountered a net loss of some 1100 t of daily ore capacity in 2000, but there was a net gain of some 100 mining jobs. Although the net capacity loss was caused by the Red Lake mine's relatively small ore capacity, the exceptionally high-grade nature of the mine ore will, on the other hand, firmly establish the mine's position as Canada's largest gold producer into the foreseeable future.

Manitoba

During 2000, one new mine opened and one closed in Manitoba. The 500-t/d Chisel North zinc mine near Snow Lake was brought on stream in August. The mine has been developed in two phases since 1998 at a total capital cost of $50 million. Production is estimated at 16 000 t of zinc annually. Mine reserves at the start of mining stood at 2.4 Mt grading 10.8% zinc, sufficient to sustain at least 14 years of production. The mine was brought on stream by owner Hudson Bay Mining and Smelting Co., Limited at an important time to provide the much-needed ore feed to the Snow Lake concentrator and to allow time for the development of the company's much larger 777 mine nearby, which is scheduled to come on stream in 2003. The 1200-t/d Keystone gold mine near Lynn Lake closed in April when mine reserves at the Farley pit were depleted. The mine first came on stream in August 1993 with production from the BT pit, which was mined out in June 1996. The Farley pit was brought on stream three months later. As a result, the province incurred net losses of 700 t/d of productive ore capacity and 30 mining jobs in 2000.

Alberta

Two coal mines shut down in Alberta in 2000 as a result of declining metallurgical coal prices in recent years. Production was suspended at the 6500-t/d Smoky River coal mine near Grande Cache in March due to financial difficulties, forcing owner Smoky River Holdings Ltd. into receivership. At the time of production suspension, the mine was the only open-pit and underground coal mine in Canada. In October, Grande Cache Coal Company acquired the mine, plant and rail loading facilities. As coal prices have since strengthened, the new company has applied for a mining permit to re-open the mine. The Gregg River coal mine at Gregg River closed at the end of August due to high costs, low coal prices, and recently encountered unfavourable geological conditions. The mine first began production in 1983. As a result, the province suffered net losses of 12 000 t/d of coal production capacity and some 770 mining jobs in 2000. Prior to 2000, the last time a mine either opened or closed in Alberta was in 1995 when the Sheerness coal mine near Hanna was brought on stream.

British Columbia

With two significant mine closings in 2000, British Columbia was again hit hard by mine closings. The 18 000-t/d Quintette coal mine near Tumbler Ridge closed in August due to high costs and declining coal prices in recent years and the inability to renew the existing coal supply contract with Japanese steelmakers. The mine began in 1984 and was the largest coal mine in the province. The 1500-t/d Cassiar asbestos operation suspended production in December after the mill was damaged by a fire. The operation recovers asbestos from low-grade surface ore stockpiles and tailings from previous mining. The current owner, Cassiar Magnesium Inc., intends to resume production as soon as damages are repaired. As there were no new mines or mine re-openings to offset the effect of mine closings, the province incurred significant net losses of some 20 500 t/d of ore capacity, mostly metallurgical coal capacity, and some 550 mining jobs.

Northwest Territories

With the re-opening of the Giant gold mine at Yellowknife in January, there are now two producing gold mines in the Northwest Territories. The Giant mine was shut down in September 1999 after the bankruptcy of former owner Royal Oak Mines Inc. in April of that year. As the new owner, Miramar Mining Corporation acquired the mine as a satellite deposit to its Con mine nearby; however, only the higher-grade Supercrest orebody was reactivated for production. Miramar's plan is to produce 130 000 oz of gold annually from the two mines at Yellowknife, with 100 000 oz from the Con mine and the remaining 30 000 oz from the Giant mine. Based on the current rate of production, ore reserves from the Supercrest orebody will unlikely provide sufficient ore feed beyond 2002. Although the Giant orebody hosts additional mineral resources that could be developed and reclassified into reserves by using a more realistic average gold price to reflect the market conditions, the refractory and high arsenic nature of the ore may dampen the future prospects of the Giant operation unless satisfactory treatment and disposal of the arsenic trioxide produced as a by-product can be developed. About 40 mining jobs were created when the Giant mine was brought back into production in early 2000.

Nunavut

The Lupin gold mine at Contwoyto Lake re-opened in April after two years of production suspension due to high costs and low gold prices. A re-engineering study, completed in late 1998, identified savings that helped lower production costs. As a result, the mine produced 117 729 oz of gold at a cash cost of US$228/oz in 2000. Annual gold production is expected to be 150 000 oz at an average cash cost of US$245/oz or lower. In April 2000 when it re-opened, the mine hosted some 543 000 oz of gold reserves and an additional 221 000 oz in the resource category, sufficient to sustain production at least until 2004. Drilling indicates additional mineralization at depth. The company's Ulu deposit, which is located some 160 km north of Lupin and hosts an ore reserve of 1.7 Mt grading 10.97 g/t gold, could also be an additional ore source for the Lupin mill. The capital cost for re-opening the Lupin mine was estimated at US$12 million. About 320 mining jobs were created at the mine. As the only gold mine in the territory, the re-opening of Lupin brought back much-needed economic strength into the region.

MINE EXPANSIONS AND EXTENSIONS

Despite continued low prices for many mineral commodities in 2000, at least eleven significant mine expansion and extension projects, mostly precious and base-metal mines, were initiated or undertaken in the year (Table 2): one in Newfoundland, three in Quebec, six in Ontario and one in Manitoba. Six of these projects involved the continuation of existing programs and five were newly announced mine expansion and extension projects, including two world-class mines.

Newfoundland

Iron Ore Company of Canada's $1.1 billion, six-year expansion and modernization program for its mine, concentrator and pellet plants in Labrador and Quebec continued in 2000. However, due to poor market conditions for iron ore in the first half of 2001, the completion of a $361.5 million capital program to reactivate the pellet plant at Sept-Îles, Quebec, has been postponed. The plant, which was mothballed in 1982, was scheduled to re-open in 2002, with the creation of 140 long-term jobs.

Quebec

The US$218 million expansion program that started in 1997 at the LaRonde gold mine in Quebec continued in 2000. During the year, the mill capacity was further increased to 4535 t/d from 3265 t/d, enabling an increase in gold production in the fourth quarter of over 300% to 71 008 oz, compared to 1999, with a 74% decrease in cash costs to US$95/oz. At the end of 2000, mineable ore reserves stood at 30.53 Mt (33.66 million tons) grading 3.429 g/t (0.10 oz/ton) gold, 80.2 g/t (2.34 oz/ton) silver, 4.4% zinc and 0.32% copper. Total mineral resources including ore reserves were 53.54 Mt (59.017 million tons) grading 4.457 g/t (0.13 oz/ton) gold, 58.3 g/t (1.70 oz/ton) silver, 2.68% zinc and 0.50% copper. This represents total gold reserves and resources of 7.8 million oz, an increase of 28% over 1999. Deep exploration drilling encountered large thicknesses of gold-copper mineralization and suggested a deposit strike length of approximately 625 m, with the deposit still open in all directions.

The key part of an expansion program at the Doyon Division, which started in 1998, came to a conclusion in 2000. During the year, capital expenditures for the Division totaled $10.7 million ($21 million in 1999), consisting mainly of deferred development in the tenth and twelfth level mining blocks at Doyon and mine deepening at Mouska, which was completed in December. In 2000, the Division produced 231 700 oz of gold, 5% less than in 1999, at a cash cost of US$214/oz (US$203/oz in 1999). As of December 31, 2000, ore reserves at the Doyon Division stood at 7.5 Mt grading 6.0 g/t gold, containing 1.5 million oz. Measured and indicated resources total 1.1 Mt grading 4.2 g/t gold and inferred resources total 6.0 Mt grading 5.5 g/t gold. In 2001, capital investment will be reduced to $7.8 million and will primarily be allocated to Doyon mine development above level 12.

At the Niobec niobium mine near Chicoutimi, Phase 1 of a $15.7 million, two-phase capital program that began in 1998 to develop deep ore and expand production capacity has expanded the mine reserves to 11.4 Mt grading 0.73% Nb_2O_5 in early 2001, sufficient to sustain mine production to at least 2010. Phase 1, representing the first 20% expansion phase at a cost of about $6.2 million, also increased the mill capacity to 2700 t/d from 2400 t/d. For 2001, planned capital investment is about $2.2 million, which will be allocated for the Phase 2 expansion and is expected to boost production by another 20%.

Ontario

The Red Lake gold mine at Balmertown embarked on an ambitious mine expansion and extension program soon after it re-opened in 2000, and continued mine-site exploration and development successes have led to significant additions of ore reserves and an upward revision in the production forecast. By the end of 2000, ore reserves at the High Grade Zone had grown to 1.633 Mt grading 57.60 g/t (1.68 oz/ton) gold, or 3.02 million oz, a 21% increase since production restarted in August. A consistently higher-than-expected head grade has prompted owner Goldcorp Inc. to increase the gold production forecast for 2001 to 350 000 oz. This was revised upward to 400 000 oz in April 2001 and to 440 000 oz in June, with the cash production cost dropping to US$70/oz from a previous forecast of US$75/oz. In addition, the refractory sulphide material also grew to 1.633 Mt grading 12.685 g/t (0.37 oz/ton) gold at the end of 2000, a 32% increase. A further revision of ore reserves and a production forecast are expected in September 2001.

A major $208 million expansion program that started in 1998 at the Lac des Iles palladium mine near Thunder Bay continued in 2000 and is on schedule to triple mine production to 250 000 oz, or 5% of the world's annual palladium output by 2002. The new 15 000-t/d concentrator, which was completed in April 2001, is six times the previous capacity of 2400 t/d. At the end of 2000, measured and indicated resources at the mine stood at 146 Mt grading 1.57 g/t palladium, 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel. A further 20 Mt were classified as inferred. The total resources contained some 8.4 million oz of palladium. At the new production rate of 250 000 oz/y, the mine life will be at least 11 years. At full production starting in 2002, annual mine output will also include 23 440 oz of platinum, 18 000 oz of gold, 5.6 million lb of copper and 1.9 million lb of nickel. The average cash cost over the mine life, net of by-product credits and royalty, is estimated at US$160/oz of palladium. The mine-site work force is expected to increase by 120 to 250 when the expansion is completed in 2002.

In July 2000, Falconbridge Limited announced a two-stage, $640 million capital program to develop Mine D, which will extend from 2100 m to 3100 m below surface at the Kidd Creek mine in Timmins. A feasibility study completed in June 2000 suggests that Mine D is expected to begin production in 2004 and will contribute 2 Mt/y of ore when its full production level is reached. Stage 1 of the development will take the mine to the 2700-m level and Stage 2, which is scheduled to begin development in 2009, will extend the mine down to 3100 m, making Kidd Creek the deepest base-metal mine in the world. Stage 1 involves the development of 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver, whereas ore for Stage 2 development is estimated at 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. The project is by far the largest deep ore development and mine extension project in Ontario.

In addition to the existing Creighton mine expansion, Inco Limited launched two new expansion programs for its nickel mines in Sudbury, Ontario, in 2000. At the McCreedy East mine, a new $46 million (US$33 million) program was initiated in June to develop a high-grade nickel deposit. It will involve mine development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004, with metal production of 21 772 t of nickel and 41 700 t of copper. The mine has other mineral zones and has the potential to extend its current life of 15 years. The McCreedy East mine, which underwent a $194 million expansion between 1997 and 1999, is one of Inco's four key mines in Ontario and one of the company's lowest-cost mines in the province. The other three are the Creighton, Copper Cliff North and Copper Cliff South mines. During 2000, Inco decided to proceed with the development of a low-grade component of the Stobie mine. This development and other related mine-life extension work in the main part of the mine is expected to enable it to produce over 20 000 t of contained nickel annually over the next 15 years starting in 2001. Capital expenditures amounted to some $16 million in 2000. At the Creighton mine, a US$125 million, two-phase capital program launched in 1998 to extend mine life at depth and to expand production was progressing well in 2000. Phase 1 of this deep development project, which aims to develop proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper located between the 7400 and 7660 levels, is expected to be completed in 2001, with ore sufficient to sustain mine production until 2013. Capital investment in 2000 amounted to US$14 million. The second phase, planned for the period 2001-05, will develop 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper located between the 7660 and 8180 levels and will provide ore for production from 2005 to 2019. As the current average grades of Inco's Ontario Division mines are 1.3% nickel and 1.2% copper, the deep development project at Creighton is undoubtedly one of the company's most significant mine extension and expansion projects in Ontario in recent years. When this deep development project, dubbed "Creighton Deep" by Inco, is fully operational in 2002, annual production is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals.

Manitoba

In February 2000, Inco announced a two-year, US$48 million ($70.4 million) plan to deepen the

Birchtree nickel mine near Thompson to extend the mine life by at least 15 years. A similar plan was announced three years ago but was postponed. A recent study successfully demonstrated that the operating cost can be reduced by more than 25% and a redesigned mine development plan could further lower costs and accelerate cash flow. Deepening the mine will increase ore reserves to 13.6 Mt grading 1.79% nickel and ore production will increase to 3175 t/d from the current 1635 t/d. After deepening, the mine is expected to reach full production in 2004. Inco is also studying the deepening of its Thompson 1-D orebody and is re-surveying the entire Thompson Nickel Belt. These activities are all part of Inco's strategy to focus on discovering new mineralization at and near existing mines and previously known deposits.

In addition to the above major projects, several mines across Canada have also undergone relatively significant expansion or mine-life extensions in 2000. In northern Quebec, the annual production rate at the Raglan nickel-copper mine was increased to the 1-Mt level from 800 000 t in 1999. In an effort to lower production costs, expansion continued at the Sigma-Lamaque mining complex near Val-d'Or. In Alberta, a decision in April 2000 to mine an additional 1.2 Mt of metallurgical coal has extended the mine life at the Luscar coal mine by six months to the end of 2002 as a result of improved market conditions for coal. At the Polaris zinc-lead-silver mine in Nunavut, better-than-projected pillar recovery, combined with the addition of 350 000 t of ore from a 6000-m drilling program, is expected to extend the mine life to mid-2002. The mine was previously scheduled to close at the end of 2001.

Overall, the major mine expansion and extension programs described above continue to indicate that, due to difficult times in recent years brought about by lingering weak metal prices and financing difficulties, mining companies in Canada have been concentrating their financial resources on mine-site exploration and they continue to discover new ore at existing mines. The successes of such discoveries and follow-up developments have enabled the mines to extend their lives and expand production, which in turn has enabled the mines to reduce production costs and stay competitive and economically viable. Although most expansion or extension projects seldom resulted in large increases in new mining jobs, over 300 new jobs were created from the 11 projects in 2000, most significantly at the LaRonde and Lac des Iles mines; these were sufficient to mitigate job losses due to production cutbacks at many gold, uranium and coal mines during the year.

IMPACT

In 2000, new mines and mine re-openings brought on stream some 5500 t of daily ore production capacity and created some 1000 mining jobs, the lowest number of new jobs in a decade. However, about 42 700 t/d of ore capacity and 2100 jobs were lost from mine closures and production suspensions, resulting in a net loss of six mines, significant net losses of 37 200 t of daily ore capacity and more than 1100 direct mining jobs. While the Magnola magnesium recovery operation and the Red Lake and Lupin gold mines contributed 845 jobs, or 85% of the employment gains from mine openings, these were overshadowed by the loss of 1288 jobs (or 60%) from the closing of three coal mines (Smoky River, Gregg River and Quintette) alone. The closure of the three coal mines was also the main cause of the large imbalance in the net employment and ore capacity losses in 2000.

In addition, production cutbacks again resulted in significant job losses during the year, especially at gold, base-metal, uranium and coal mines. Total job losses due to production cutbacks during the year were estimated at more than 250. Although this was a substantial improvement over 1999 in which more than 900 jobs were lost from production cutbacks, it nevertheless continued to worsen the alarming trend of job losses from mine closings. This also makes 2000 the fourth consecutive year of job losses due to cutbacks at producing mines across Canada.

Mine openings ensure immediate access to new or redeveloped sources of economic mineral supply, new production capacity and capability, and new mining jobs. They also reflect Canada's mine-building ability and its attractiveness in the face of global competition and globalization. In 2000, mine openings continued to be outnumbered by mine closings and a recent trend in which base-metal mines are lacking in both number and size also appears to have persisted. However, gold and magnesium mine openings during the year represent significant additions to Canada's total minerals and metals production capability. Overall, at full capacity, production from new and re-opened mines in 2000 is expected to add at least 20 t (644 000 oz) of gold, 16 000 t of zinc and 63 000 t of magnesium annually (Table 3) to Canada's total metal production. While most of the new gold production (75%) will come from the Red Lake mine in Ontario due to the impending closures of the Francoeur mine in Quebec and the Giant mine in the Northwest Territories in 2001 and 2002 respectively, all of the new magnesium production will come from the Magnola operation in Quebec and all of the new zinc production will come from the Chisel North mine in Manitoba. Gold production from the world-class Red Lake mine is expected to be more than adequate to offset production losses from the closure of all five gold mines in 2000. However, zinc production from Chisel North will not be sufficient to replace losses from production suspension at the Langlois mine.

Table 4 shows that new and re-opened mines in 2000 have also added over 114 t, or 3.6 million oz, of gold reserves, 259 200 t of zinc reserves, and 13.3 Mt of magnesium reserves to Canada's total reserves of these metals. All of the new metal reserves are essential for replenishing depleted reserves due to production and for sustaining Canada's minerals and metals production capability. While the addition of significant new gold reserves in 2000 will help boost Canada's dwindling gold mine reserves and production, the addition of substantial new magnesium reserves has now ensured Canada's position as a significant long-term supplier of this metal in the world market.

NEW DEVELOPMENTS EXPECTED TO BECOME MINES IN 2001

Preliminary estimates, based on mine development activities in 2000 and in the first half of 2001, indicate that five mines, most of which will be new mines, could come on stream in 2001. Among the most promising new mine projects are Hammerdown (gold) and Buchans (barite) in Newfoundland, Beaufor (gold) in Quebec, and Ashcroft (roofing aggregate) in British Columbia. In addition, the long-awaited CanTung tungsten mine in the Northwest Territories may finally be re-opened at year-end.

In addition, several previous mine expansion and extension projects, as well as new ones that were initiated in 2000, are expected to continue in 2001 with others likely to be announced during the year. These mine expansions and mine-life extensions, together with new mine developments, are central to sustaining mining and production in Canada. In the face of weak prices for many minerals and metals and without having to resort to significant layoffs, mine expansion remains an effective option by which production costs can be lowered and productivity increased at an existing mine. Such an option is especially beneficial for mines that have significant new ore discoveries, for example, the LaRonde and Niobec mines in Quebec; the Lac des Iles, Red Lake, Kidd Creek, Creighton, McCreedy East and Stobie mines in Ontario; and the Birchtree mine in Manitoba, all of which have been discussed above, as well as many others that are still in the planning stages.

OUTLOOK

With the exception of short-lived surges in metal prices, the overall global metal price downturn of recent years lingered on during 2000 and the first half of 2001 and continued to hamper exploration and mine development in Canada and elsewhere. The negative effect was particularly severe on mine openings in Canada's traditionally strong areas of gold, base-metal and coal production. Uranium mining has also been adversely affected. As mine closings continue to outnumber mine openings, Canadian companies continued to respond by closing down high-cost mines, consolidating operations by integrating mines, cutting back on production and work force, imposing or extending vacation shut-downs, revamping mining methods, expanding production capacity, or postponing mine openings and developments. However, many mines have reached their limits for further technical or economic improvements beyond which costs for improvement would outweigh benefits and shut-down becomes an inevitable option.

As the current economic slowdown in the United States set in during the second half of 2000, it adversely affected the long-awaited economic recovery in Japan and prolonged the current global metal price downturn. The present slowdown continues to dampen economic growth and demand for metals and minerals, especially in North America, Australia, Asia and Europe, forcing prices for many key metals such as copper, zinc, and lead to decline to record low levels in the first half of 2001. This has continued to put a lid on domestic exploration and development. Even diamonds, one of the most robust minerals, has seen its demand slipping since 2000. As a result, many development projects in Canada that were shelved since 1997 and subsequently revived for development since early 2000 have again been negatively affected. New projects are not spared. Although there has been a slight improvement in both exploration and mine financing since late 1999, the mining industry was disappointed that a downturn in the high-tech industry has not resulted in a significant shift of investment funds into mining. An upturn in the recent U.S. economic doldrums is crucial for metal price recovery and it will have a positive effect on mine development and mine openings in Canada. However, such recoveries may not occur until the second half of 2002 due to a still weak demand for key metals that is tied to weak consumer demand in the United States. Consequently, the short-term outlook (less than two years) for significant new mine developments and mine openings in Canada is dim. Most mines are expected to continue to focus on mine-site exploration and development to extend mine life and on an improvement in production costs.

If mineral commodity prices strengthen in 2002, exploration and development activities will likely surge and many projects can be expected to be developed quickly, especially several of the gold mine projects. In recent years, Canadian companies have shown great ability and speed in bringing on stream small to medium-sized mines to capitalize on a timely basis on shorter-than-expected upturns in mineral and metal cycles. However, large projects, which require years of planning and development and tend to depend more on longer-term price strength, still could be brought on stream upon moderate price increases if price stability can be expected or if reasonable levels of production hedging can be established. Under the current economic slowdown in the United States and Japan, which negatively affected demand for minerals and metals, mineral commodity price increases will depend largely on the recovery of these two key economies. A sustained economic recovery will stimulate economic growth and development, which will in turn bring about price stability and availability of financing for mine development. The medium (two to five years) to long-term (beyond five years) outlook for mine development and mine openings in Canada is good as more than two dozen significant mining projects are at the development stage, including several world-class deposits. At least another two dozen are at or near the advanced exploration stage.

Notes: (1) Information in this review, based mostly on company reports and communications with companies, was current as of June 30, 2001.
(2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. MINE OPENINGS AND CLOSINGS IN CANADA, 2000

Province/ Territory	New Mines			Mines Re-Opened			Mines Suspended			Mines Closed		
	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals
Quebec	–	–	1	1	–	–	2	1	1	–	1	–
Ontario	–	–	–	1	–	–	1	–	–	1	–	–
Manitoba	–	1	–	–	–	–	–	–	–	1	–	–
Alberta	–	–	–	–	–	–	–	–	1	–	–	1
British Columbia	–	–	–	–	–	–	1	–	–	–	–	1
Northwest Territories	–	–	–	1	–	–	–	–	–	–	–	–
Nunavut	–	–	–	1	–	–	–	–	–	–	–	–
Canada, total by commodity group	–	1	1	4	–	–	4	1	2	2	1	2
Total Canada		2			4			7			5	

Source: Natural Resources Canada, based on company reports.
– Nil.

TABLE 2. MINE OPENINGS, RE-OPENINGS, EXPANSIONS, EXTENSIONS, SUSPENSIONS AND CLOSURES IN CANADA IN 2000

Mining Project	Location	Province/ Territory	Ore Capacity	Employment During Mine Life[1]	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
NEW OPERATIONS									
Base Metals									
Magnola	Asbestos	Que.	1 000e	350	September	Tailings	Magnesium	Magnola Magnesium Inc. and Société générale et financement du Québec	Construction of the Magnola magnesium recovery plant began in April 1998 and production began in September 2000. The operation involves the processing of at least a part of the estimated 250 Mt of asbestos (mostly serpentine) tailings accumulated from decades of asbestos mining. At the start of production in September 2000, readily processible serpentine tailings reserves totaled 57.6 Mt grading 23.1% magnesium. Magnesium metal is produced by a three-stage leaching (magnesium chloride production) magnesium metal conversion process. Initially, the capital cost of the plant was estimated at $733 million. However, start-up problems, including a fire in one of the electrolytic cells that occurred as a result of a mechanical failure in a cooling circuit, have caused delays in the commissioning of the production sector, a lower-than-expected production level, and higher capital costs. The total capital investment is now estimated at $920 million. With a designed production capacity of 63 000 t/y, which is equivalent to 16% of global demand, Magnola is the largest magnesium operation in the world. In addition to producing primary metal from asbestos tailings, the operation can also handle alloy recycling services.
Chisel North	Snow Lake	Man.	500	65	August	U/G	Zinc	Hudson Bay Mining and Smelting Co., Limited	The Chisel North mine at Snow Lake began production in August 2000. Developed in two phases since August 1998 at a total capital investment of $50 million, the mine was brought on stream at an important time to provide ore feed to the company's Snow Lake concentrator. At a capacity of 500 t/d of ore, zinc production is estimated at 16 000 t/y. At the start of mining, ore reserves were 2.4 Mt grading 10.8% zinc, sufficient to sustain more than 14 years of production.
RE-OPENINGS									
Precious Metals									
Francoeur	Rouyn-Noranda	Que.	1 125	62	February	U/G	Gold	Richmont Mines Inc.	Production at the Francoeur mine was suspended for four months beginning in September 1999 due to high costs and low gold prices. During the suspension, the mining method was changed to the long-hole method from the more expensive room-and-pillar method and the company continued to develop Zone 7, a new ore zone. As planned, commercial production resumed at the beginning of February 2000. With an exploration budget of $500 000, the company plans to conduct underground exploration in early 2001 to confirm

TABLE 2 (cont'd)

Mining Project	Location	Province/ Territory	Ore Capacity	Employment During Mine Life[1]	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
RE-OPENINGS (cont'd)									
Precious Metals (cont'd)									
Francoeur (cont'd)									the existence of an ore zone close to level 15 of Shaft 7 and surface exploration work. However, the company intends to close the mine towards the end of September 2001 if the work does not lead to the discovery of a significant ore zone as ore reserves will be depleted by then. Currently, mine ore is milled at the company's nearby Camflo mill.
Red Lake	Balmertown	Ont.	550	175^{e}	August 1	U/G	Gold	Goldcorp Inc.	The Red Lake mine resumed production in August 2000 after four years of production suspension that began with a strike that broke out on June 23, 1996. The labour dispute was resolved in April 2000. However, production did not resume from mining the refractory ore that was in progress when the strike occurred, but from the newly discovered High Grade Zone of non-refractory ore. The significant size of this rich High Grade Zone ore enabled the mine to be redeveloped into a world-class high-grade gold mine with a new milling capacity of 550 t/d. Commercial production was attained on January 1, 2001. Total capital cost of redevelopment was US$56 million. Gold production in the five-month period in 2000 was 85 116 oz with an additional 15 994 oz contained in the mill circuit. Initially, annual production was planned at 240 000 oz of gold at a cash cost of US$88/oz. On February 26, 2001, the company announced a new production forecast of 350 000 oz of gold for 2001. This was revised to 400 000 oz on April 5. On June 11, 2001, the company again revised the forecast to 440 000 oz at a cash cost of US$70/oz, making the Red Lake mine the largest and lowest-cost gold mine in Canada and one of the lowest-cost gold mines in the world. As of December 31, ore reserves at the High Grade Zone stood at 1.633 Mt grading 57.6 g/t gold (1.68 oz per ton of gold), or 3.02 million oz. Goldcorp was the only North American gold company to apply an average gold price of US$275/oz instead of US$300/oz in its reserves estimate to better reflect current gold prices. In addition, the Red Lake mine hosts 1.633 Mt of refractory sulphide material grading 12.685 g/t (0.37 oz/ton) gold, which was the ore that kept the mine running continuously for 48 years until a strike erupted in 1996. For 2001, the company is focusing its exploration below the 37 level of the mine. It is also accelerating exploration on two high-grade gold properties nearby. These are the Cochenour mine, located about 8 km northwest of the Red Lake mine, and the Abino prospect, which is located some 10 km north of the Cochenour mine.

Giant (Supercrest Zone)	Yellowknife	NWT	300	40	January	U/G	Gold	Miramar Mining Corporation	Mining restarted at the Giant mine in Yellowknife in February 2000. The mine was shut down in September 1999 after the bankruptcy of former owner Royal Oak Mines Inc. in April of that year. Miramar Mining acquired the mine as a satellite deposit to its nearby Con operation. A plan announced in February 2000 would see the mine produce 130 000 oz of gold from the company's two mines at Yellowknife, with 100 000 oz from the Con mine and the balance of 30 000 oz coming from the small but higher-grade Supercrest orebody at the Giant mine. Although the mine hosts additional mineral resources of 5.17 Mt grading 7.88 g/t gold containing 1.33 million oz of gold, these resources have not been reclassified using a more realistic average gold price to reflect current market conditions.
Lupin	Contwoyto Lake	Nun.	2 000	320^{e}	April	U/G	Gold	Echo Bay Mines Limited	After more than two years of shut-down and a redevelopment cost of US$12 million, the Lupin gold mine at Contwoyto Lake in Nunavut re-opened in April 2000. First mined in October 1982, Lupin was placed on care and maintenance in January 1998 due to falling gold prices and a high cost structure. A reengineering study completed late in 1998 identified savings that helped lower costs. During 2000, the mine produced 117 729 oz of gold at a cash cost of US$228/oz. Annual gold production is expected to be 150 000 oz at an average cash cost of US$245/oz or lower. When production restarted in April, the mine hosted some 543 000 oz of gold reserves and another 221 000 oz of gold resources, sufficient to sustain production at least until 2004. Current development has reached a depth of 1400 m below surface. Drilling indicates additional mineralization at depth. Confirmation drilling is under way. As well, the company's Ulu satellite deposit, located approximately 160 km north of Lupin, hosts ore reserves of 1.723 Mt grading 10.97 g/t gold. This represents potential additional mill feed for Lupin.

EXPANSION AND EXTENSIONS

Precious Metals

Doyon Division	Cadillac	Que.	3 500	507	1998-2000	U/G	Gold	Cambior inc.	A capital program that started in 1998 to combine the Mouska mine operation with the Doyon mine (into the Doyon Division) to develop deep ore at the two mines was substantially completed in 2000. During the year, capital expenditures for the Division totaled $10.7 million, compared with $21 million in 1999, consisting mainly of deferred development in the 10th and 12th-level mining blocks at Doyon and mine deepening at Mouska. In 2000, the Division produced 231 700 oz of gold, 5% less than in 1999, at a cash cost of US$214/oz, which was 5% higher than in 1999. At the end of 2000, mine reserves stood at 7.5 Mt grading 6.0 g/t gold or about 1.5 million oz. In addition, measured and indicated resources totaled 1.1 Mt grading 4.2 g/t gold and inferred resources of 6.0 Mt grading 5.5 g/t gold. In 2001, a $7.8 million capital investment is planned for ore development above level 12 at the Doyon mine.

TABLE 2 (cont'd)

Mining Project	Location	Province/ Territory	Ore Capacity (tonnes/day)	Employment During Mine Life1	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
EXPANSION AND EXTENSIONS (cont'd)									
Precious Metals (cont'd)									
LaRonde	Val-d'Or	Que.	4 535	360	1997-2004	U/G	Gold	Agnico-Eagle Mines Limited	Since the discovery of extensive gold-copper-zinc-silver mineralization at depth, the LaRonde mine has embarked on a series of ambitious capital programs to expand production and to lower costs since 1997. New drilling results released in January 2000 indicated that thick veins of gold and copper continue down to about 3 km below surface. As of December 31, 2000, mineable reserves were 30.53 Mt grading 3.429 g/t gold, 80.2 g/t silver, 4.4% zinc and 0.32% copper. Total mineral resources, including ore reserves, were 53.54 Mt grading 4.457 g/t gold, 58 g/t silver, 2.68% zinc and 0.50% copper, representing 7.8 million oz of gold, an increase of 28% over 1999. In a recently revised plan to mine deep ore, Agnico-Eagle Mines announced its decision to further expand milling capacity from 4500 t/d to 6350 t/d. While a previously announced US$218 million, two-phase expansion program to increase mill capacity to 4535 t/d from 3265 t/d was completed in the fourth quarter of 2000, which will enable annual gold production to increase substantially by 2004, this new expansion program will accelerate expansion and result in further increases in gold production. The company's 6350-t/d mine plan contemplates an increase in gold production from an estimated 229 000 oz of gold in 2001 to 341 000 oz in 2002, 373 000 oz in 2003 and 396 000 oz in 2004. As well, the previously estimated cash production cost reduction to US$104/oz by 2004 is expected to further decline by about 15% due to economies of scale and to the anticipated higher gold production. Assuming a long-term gold price of US$280/oz, the rate of return on the US$40 million investment to expand the operation from 4535 t/d to 6350 t/d is over 20% with a payback period of approximately three years.
Red Lake	Balmertown	Ont.	550	175•	2000-2001	U/G	Gold	Goldcorp Inc.	Since the re-opening of the Red Lake mine in August 2000, ore reserves at the mine have grown considerably. At the start of production resumption, ore reserves at the High Grade Zone were 1.27 Mt grading 46.97 g/t (1.37 oz/ton) gold and annual gold production was planned at 240 000 oz, which would have quadrupled production at the mine prior to its shut-down in June 1996. Continued mine-site exploration and development successes have pushed both mine reserves and production forecasts upward. At the end of 2000, mineable reserves of the High Grade Zone increased to 1.633 Mt grading 57.60 g/t (1.68 oz/ton) gold or 3.02 million oz. Consistently higher ore grades at the mill head than the reserves have prompted owner Goldcorp to increase its annual gold production forecast to 350 000 oz for 2001. This was revised to 400 000 oz in April 2001 and was

									again revised upward to 440 000 oz in June 2001, with the cash production cost dropping to less than US$70/oz from a previous forecast of US$75/oz. As well, refractory sulphide material, from which mine production came prior to the 1996 shut-down, also grew from 1.27 Mt grading 12.34 g/t (0.36 oz/ton) gold in August 2000 to 1.633 Mt grading 12.685 g/t (0.37 oz/ton) gold by the end of 2000. A review of ore reserves is expected in September 2001.
Lac des Iles	Thunder Bay	Ont.	2 400	130	1998-2002	O/P	Palladium-platinum, gold, copper, nickel	North American Palladium Ltd.	A major $208 million expansion program at the Lac des Iles palladium mine that began in 1998 continued in 2000. The expansion is on schedule and budget to triple annual palladium production to 250 000 oz, or 5% of the world's annual palladium supply, by 2002. North American Palladium completed the needed funding in June 2000. Commissioning of the new 15 000-t/d concentrator, which will be six times the current capacity of 2400 t/d, is scheduled for the third quarter of 2001. At an annual production rate of 250 000 oz, the mine life will be at least 11 years. The mine also produces significant amounts of platinum, gold, nickel and copper. At full production, starting in 2002, annual output will include 21 600 oz of platinum, 16 300 oz of gold, 5.6 million lb of copper and 1.9 million lb of nickel. Total cash costs over the mine life, net of by-product credits and royalty, are estimated at US$160/oz of palladium. Due to a change in concept to explore and develop lower-grade and larger-tonnage ore material in and around the Roby zone (the Roby pit is currently the main source of mine production) and the newly discovered Twilight zone, palladium resources have climbed to 6.4 million oz from 5 million oz in 1999 and 1.3 million oz in 1998. As of January 1, 2000, ore reserves were 71.9 Mt grading 1.76 g/t palladium, containing more than 4 million oz of palladium. As of July 31, 2000, in addition to the mineable reserves, the overall resource stood at 121.7 Mt grading 1.63 g/t palladium. The mine has a pre-expansion work force of 130. The mine-site work force is expected to increase to 250 when expansion is completed in 2002. The Lac des Iles mine is Canada's only primary palladium mine.
Base Metals									
Niobec	Chicoutimi	Que.	2 700	n.a.	1998-2001	U/G	Niobium, ferro-niobium	Teck Corporation and Cambior Inc.	A $15.7 million capital program that started in 1998 to deepen the Niobec mine shaft to develop deep mineral reserves in the lower or third block, to develop a ramp, and to install a new crusher had expanded the mine reserves to 11.4 Mt grading 0.73% Nb_2O_5 by early 2001, sufficient to sustain production at the current rate to 2010. Phase 1, representing the first 20% expansion phase, which included an expansion of the mill capacity, was completed in 2000 at a capital cost of $6.2 million, compared to $3.8 million in 1999. The mill capacity, expanded at a cost of $4 million, was increased to 2700 t/d from 2400 t/d. For 2001, the planned capital investment is about $2.2 million, which is expected to be applied to a second phase of the planned expansion to boost production by another 20%. In 2000, the mine produced 2170 t of niobium, slightly less than in 1999 due to lower grades and recoveries. Production in 2001 is expected to increase to 2860 t of niobium. Niobec is the only producer of niobium in North America and is one of only a few mines of its kind in the world. The mine produces a pyrochlore

TABLE 2 (cont'd)

Mining Project	Location	Province/ Territory	Ore Capacity	Employment During Mine Life[1]	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
EXPANSION AND EXTENSIONS (cont'd)									
Base Metals (cont'd)									
Niobec (cont'd)									concentrate that is transformed into ferroniobium grading 66% niobium using an aluminothermic converter. The product is added to steel and various alloys to improve mechanical properties and corrosion resistance. In March 2001, Teck Corporation sold its 50% interest in the Niobec mine to Mazarin Inc. for $48 million.
Kidd Creek (Kidd Mining Division)	Timmins	Ont.	12 500	950^{e}	2000-2004	U/G	Copper, zinc, silver	Falconbridge Limited	In July 2000, Falconbridge Limited announced the development of Mine D – a deep ore development program to extend the mine life of its Kidd Creek copper-zinc-silver mine at Timmins, Ontario. Development of Mine D will take place in two stages, with Stage 1 taking the mine from 2100 m to about 2700 m in depth and Stage 2 taking it to a depth of 3100 m. This will make Kidd Creek the deepest base-metal mine in the world. The Stage 1 portion of the mine contains about 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver. Ore for Stage 2 development is estimated at 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. Production is expected to begin in 2004. Annual ore output is estimated at 2 Mt when full production is reached. The total capital investment will be $640 million. Currently, the Kidd Mining Division directly employs about 450 workers. In addition, there are about 500 contractors.
Creighton	Sudbury	Ont.	3 500^{e}	525	1998-2001 (Phase 1), 2001-2005 (Phase 2)	U/G	Nickel, copper, cobalt, precious metals	Inco Limited	A US$125 million, two-phase capital program to extend mine life and to expand mine production at the Creighton nickel mine in Sudbury, Ontario, continued in 2000. The deep development program, which was announced by Inco Limited in April 1998, aims to develop a 6-Mt high-grade, low-cost nickel-copper deposit at depth at the Creighton mine over the next two decades. The first phase, which is near completion, will develop proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper located between the 7400 and 7660 levels. Production from this ore is expected to begin in 2001 and is expected to continue through 2013. Capital expenditures on the project amounted to US$14 million in 2000. The second phase involves the development of 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper. This ore, situated between the 7660 and 8180 levels, is expected to be mined between 2005 and 2019. In contrast, the current average grades of the Ontario Division mines are 1.3% nickel and 1.2% copper. When Creighton Deep is fully operational in 2002, annual production is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals.

McCreedy East	Sudbury	Ont.	2 700	180	2000-2001	U/G	Nickel, copper, cobalt, precious metals	Inco Limited	The McCreedy East nickel mine in Sudbury continued to expand production since its opening in 1996. Between 1996 and 1999, the mine underwent a $194 million capital program to expand ore production capacity. By the end of 1999, daily ore capacity had reached the 2700-t level. On June 7, 2000, Inco announced a new $46 million (US$33 million) project to develop a high-grade nickel deposit at its McCreedy East mine near Sudbury, Ontario. It will involve mine development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004. At this rate, metal production will be 48 million lb of nickel and 92 million lb of copper annually, up from the current 9 million lb of nickel and 82 million lb of copper. Inco expects the expansion of the McCreedy East mine to provide its Ontario Division with another source of low-cost production for at least another 15 years. The mine has other mineral zones with excellent potential to further extend the life of the mine. Inco has designated McCreedy East as one of four key mines in its Ontario Division. The other three (Creighton, Copper Cliff North and Copper Cliff South), are all in the Sudbury area. These four mines will be the company's lowest-cost mines in Ontario.
Stobie	Matheson	Ont.	4 000^e	250^e	2000-2001	U/G	Nickel, copper, cobalt, precious metals	Inco Limited	Inco Limited decided in 2000 to proceed with development of a low-grade component of the Stobie mine. This development, along with the related extension of the main portion of the Stobie mine, is expected to result in aggregate production of over 20 000 t/y of contained nickel from the mine over a period of 15 years starting in 2001. Capital expenditures amounted to some $16 million in 2000.
Birchtree	Thompson	Man.	1 635	150^e	2000-2002	U/G	Nickel, copper, cobalt, precious metals	Inco Limited	On February 14, 2000, Inco announced plans to invest US$48 million ($70.4 million) to deepen the Birchtree nickel mine near Thompson, Manitoba, which will extend the mine's life by at least 15 years. While a previous plan to deepen the mine had been postponed three years ago, the plan was re-evaluated and, as a result, an employee co-design team successfully demonstrated an operating cost reduction of more than 25% and a redesigned mine development plan that would further lower costs and accelerate cash flow. Deepening Birchtree will allow the mine to increase production to 3175 t/d from the current 1635 t/d. As well, ore reserves will increase to 13.6 Mt grading 1.79% nickel. The work, which began immediately, is expected to take two years to complete. The mine is expected to reach full production in 2004 and its production life is now scheduled to extend to 2016. Inco is also studying the deepening of its Thompson 1-D orebody and is resurveying the entire Thompson Nickel Belt. Both activities are part of Inco's overall exploration strategy to focus on discovering new mineralization near current mines and previously known deposits.

TABLE 2 (cont'd)

Mining Project	Location	Province/ Territory	Ore Capacity	Employment During Mine Life[1]	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
EXPANSION AND EXTENSIONS (cont'd)									
Other Commodities									
Carol Lake	Labrador City	Nfld.	49 500^{e} (conc. and pellet)	n.a.	1998-2003	O/P	Iron	Iron Ore Company of Canada	A $1.1 billion, six-year comprehensive capital investment program announced by Iron Ore Company of Canada (IOC) in October 1998 continued in 2000. About $650 million, or 60%, of the investment will be spent on upgrading and expanding the company's Carol Lake mine, concentrator and pellet plant near Labrador City. Another $361.5 million will be spent on reactivating the pellet plant at Sept-Îles, Quebec, which was mothballed in 1982. Completion of the Sept-Îles plant, originally scheduled for 2002, has now been postponed due to poor market conditions for iron ore in the first half of 2001.
SUSPENSIONS									
Precious Metals									
Beaufor	Val-d'Or	Que.	560^{e}	99	August	U/G	Gold	Aurizon Mines Ltd. and Louvem Mines Inc.	Production was suspended on August 24, 2000, as a precautionary measure to assess a risk of instability with some of the mine pillars. Although no decision has been made about the future of the mine, redevelopment work has been pointing towards a re-opening in late 2001.
Joe Mann	Chibougamau	Que.	1 350	260	November 10	U/G	Gold	Campbell Resources Inc.	Production at the Joe Mann mine was suspended in November 2000 due to low gold prices and the need for additional financing for mine development. The mine was shut down in September 1999 due to high costs and poor ground conditions that led to excessive dilution of ore grades. It was re-opened in April 2000 with the adoption of cut-and-fill mining. However, a change in mining method failed to lower gold production costs.
Stock	Stock Twp.	Ont.	1 300	50^{e}	November	U/G	Gold	St. Andrew Goldfields Ltd.	Mining was suspended at the Stock mine in November 2000 due to persistently low gold prices. The mine was brought on stream in October 1989. Production was suspended in July 1994. The mine resumed production in March 2000 until its recent shut-down.
Base Metals									
Langlois	Lebel-sur-Quévillon	Que.	2 500	180^{e}	November 28	U/G	Zinc, copper	Breakwater Resources Ltd.	Production at the Langlois mine was suspended in November 2000 due to problems with the main ore pass system, declining metal prices and high treatment charges. Owner Breakwater Resources Ltd. is redesigning a long-term development and operating plan for increasing production at lower operating costs. Breakwater Resources acquired the Bouchard-Hébert and Langlois zinc-copper-gold-silver mines from Cambior Inc. on May 1, 2000.

Other Commodities									
St. Onge (Orleans)	Lac St. Jean	Que.	550	75	July	O/P	Wollastonite	Orleans Resources Inc.	The St. Onge (Orleans) mine closed in July 2000 as a result of high costs, the lingering weak market for wollastonite, and the failure in finding a buyer for the mine. The $30 million mine and mill operation began production in November 1997. Production was suspended in June 1998, restarted in January 2000, and closed again in July 2000. The mine, one of the world's largest wollastonite operations, hosted more than 25 Mt of wollastonite reserves.
Smoky River	Grande Cache	Alta.	6 500e	540	March 31	O/P & U/G	Coal	Smokey River Holdings Ltd.	Production at the mine was suspended at the end of March 2000 due to company receivership. In October 2000, Grande Cache Coal Company acquired the Smoky River coal mine and plant and rail load-out facilities. The new company has applied for a mining permit to resume open-cut and underground mining.
Cassiar	Cassiar	B.C.	2 500e	50e	December	Surface	Asbestos	Cassiar Magnesium Inc.	Production was suspended in December 2000 due to substantial damage in the mill caused by a fire. The company intends to resume asbestos production as soon as the damages are repaired.
CLOSURES									
Precious Metals									
Hislop West	Matheson	Ont.	350e	25	November	O/P	Gold	St. Andrew Goldfields Ltd	The mine closed in November 2000 due to ore depletion. Production from the Hislop West open pit began in July 1999. The Hislop property hosted an underground mine that operated between 1991 and 1994 and produced 35 200 oz of gold.
Keystone	Lynn Lake	Man.	1 200	95	April	O/P	Gold	Black Hawk Mining Inc.	The Keystone gold mine closed in April due to depletion of ore reserves. The mine came on stream in August 1993 with production from the BT open pit, which was mined out in June 1996. The present Farley Lake deposit was developed to replace the BT pit and was brought into production in September 1996. Mining at the Farley Lake open pit was completed in April 2000 when pit ore reserves were depleted. However, production from the ore stockpile continued until April 2000.
Base Metals									
Gallen	Rouyn-Noranda	Que.	2 350	17	December	U/G	Zinc	Noranda Inc.	The mine closed in December 2000 due to ore depletion. Mining was substantially complete in August 2000 but production continued until December. The mine first began production in November 1981 with operations suspended in July 1982. It was reactivated in 1984, but production was again suspended in December 1985. The mine was redeveloped in 1996 and 1997 and re-opened in October 1997.

TABLE 2 (cont'd)

Mining Project	Location	Province/ Territory	Ore Capacity	Employment During Mine Life[1]	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
CLOSURES (cont'd)									
Other Commodities									
Gregg River	Gregg River	Alta.	5 500•	228	August 31	O/P	Coal	Luscar Ltd.	The Gregg River coal mine was permanently closed in August 2000 due to high costs, low coal prices and recently encountered unfavourable geological conditions. The mine began production in 1983.
Quintette	Tumbler Ridge	B.C.	18 000•	500	August	O/P	Coal	Quintette Coal Limited and Teck Corporation	The mine closed on August 31, 2000, two and a half years earlier than planned, as a result of high costs, declining coal prices in recent years with no recovery in sight, and failure to renew a coal supply contract with Japanese steel mills. The mine began production in 1984. It mainly supplied metallurgical coal to Japanese steelmakers.

Source: Natural Resources Canada, based on company reports and communications with companies.
• Estimated; O/P Open pit; U/G Underground; t Metric tonne; ton Short ton; oz Troy ounces; g/t Grams per tonne.
[1] Employment refers to workers on the company's payroll and to contract workers at an operation, or at an operation prior to its closure. [2] Mine closed and re-opened in 2000.
Note: A mine that closed and re-opened in the same year is shown under both categories.

TABLE 3. NEW PRODUCTION FROM MINE OPENINGS IN CANADA IN 2000

Mining Project	Main Commodities	Estimated Annual Production Gold (oz)	Gold (g)	Zinc (t)	Magnesium (t)
NEW OPERATIONS					
Base Metals					
Magnola	Magnesium	–	–	–	63 000
Chisel North	Zinc	–	–	16 000	
RE-OPENINGS					
Precious Metals					
Francoeur	Gold	24 000	746 480	–	–
Red Lake	Gold	440 000	13 685 520	–	–
Giant (Supercrest Zone)	Gold	30 000	933 100	–	–
Lupin	Gold	150 000	4 665 520	–	–
Planned total		644 000	20 030 620	16 000	63 000

Source: Natural Resources Canada, based on company reports and communications with companies.
– Nil.
Note: As production at both the Francoeur and Giant gold mines is expected to be suspended in the near future, the effect of gold output from these two mines on overall Canadian production will be negligible until the mines are re-opened.

TABLE 4. NEW MINERAL RESERVES FROM MINE OPENINGS IN CANADA IN 2000

Mining Project	Main Commodities	Proven-Probable Mineral Reserves Tonnage (tonnes)	Grade	In-Situ Metal Reserves Gold (oz)	Gold (g)	Zinc (t)	Magnesium (t)
NEW OPERATIONS							
Precious Metals							
Magnola	Magnesium	5 760 000	23.1% magnesium	–	–	–	13 305 600
Chisel North	Zinc	2 400 000	10.8% zinc	–	–	259 200	–
RE-OPENINGS							
Precious Metals							
Francoeur	Gold	129 700	7.543 g/t gold	31 450	978 200	–	–
Red Lake	Gold	1 632 930	57.6 g/t gold (High Grade Zone)	3 024 000	94 056 910	–	–
Giant (Supercrest Zone)	Gold	207 500●	12.41 g/t gold	82 700	2 572 260	–	–
Lupin	Gold	1 838 000	9.189 g/t gold	543 000	16 889 190	–	–
Total				3 681 150	114 496 560	259 200	13 305 600

Source: Natural Resources Canada, based on company reports and communications with companies.
– Nil; ● Estimated.
Note: As production at both the Francoeur and Giant gold mines is expected to be suspended in the fall of 2001 and in 2002, respectively, the mineral reserves of the two mines may not be treated as economical reserves after the suspension until the mines are ready to be re-opened in the future.

Canada's Global Mining Presence

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GLOBAL MARKET FOR MINERAL EXPLORATION

In 2000, the value of exploration programs planned around the world by companies of all sizes for precious metals, base metals and diamonds fell to an estimated $3.8 billion (US$2.6 billion), down by 7% from the $4.1 billion (US$2.8 billion) planned the previous year.[1] Exploration programs were reduced in most countries, but were postponed or abandoned entirely in others.

WORLD'S LARGER COMPANIES

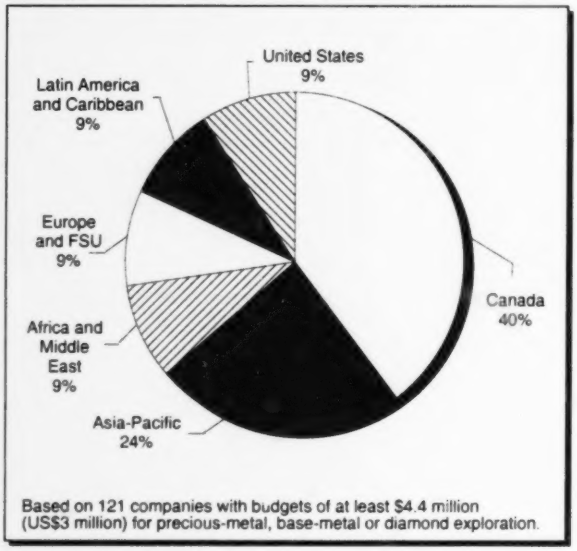
Global trends in mineral exploration are based largely on data for the world's larger companies.[2] These companies are defined here as those with annual exploration budgets of more than $4.4 million in 2000 (US$3 million). The larger companies are the only ones for which there are consistent data on worldwide exploration activity spanning a period of almost 10 years. In 2000, 121 companies based around the world each planned to spend more than $4.4 million on exploration, down from a record 279 companies in 1997.

During 2000, the world's larger companies were expected to undertake exploration programs with a combined value of $2.9 billion (US$2.0 billion) in 106 countries. The larger companies represent only about 18% of the more than 650 companies of all sizes that were active in mineral exploration worldwide in 2000. However, they account for over 80% of the value of all mineral exploration programs carried out around the globe.

LARGER CANADIAN-BASED COMPANIES

There are more mineral exploration companies based in Canada than in any other country (Figure 1). In spite of generally low prices for mineral commodities and the difficulty in raising capital, 48 Canadian-based companies each planned to spend more than $4.4 million on exploration in 2000, about the same as in 1999. In 1996, mining companies listed on Canadian stock exchanges raised a record amount of capital.[3] As a result, 141 Canadian-based companies each planned to spend more than $4 million on exploration programs around the world in 1997. Their aggregate budgets for exploration, adjusted for inflation, reached an all-time value of over $2.0 billion during that year.

Figure 1
Distribution of the World's Larger Exploration Companies, by Domicile, 2000



Based on 121 companies with budgets of at least $4.4 million (US$3 million) for precious-metal, base-metal or diamond exploration.

Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

In 2000, the total value of the exploration programs that the larger Canadian-based companies planned to undertake in both Canada and elsewhere around the world stood at almost $887 million (Figure 2), down slightly from the $916 million budgeted in 1999. The programs that Canadian-based companies planned to undertake during 2000 represent more than 30% of all larger-company exploration programs around the world. Canadians account for the dominant share, by far, of all worldwide mineral exploration activity. Their closest rivals, the Australians, account for about 20%. In 1997, Canadian programs accounted for a record 35% of the value of all exploration planned worldwide.

The larger Canadian-based companies tend to have exploration budgets that are smaller than those of the industry worldwide. In 2000, these Canadian companies had average exploration budgets with a mean of $18.5 million and a median of $8.8 million, about 20% smaller than the global averages of $23.8 million and $11.0 million, respectively.

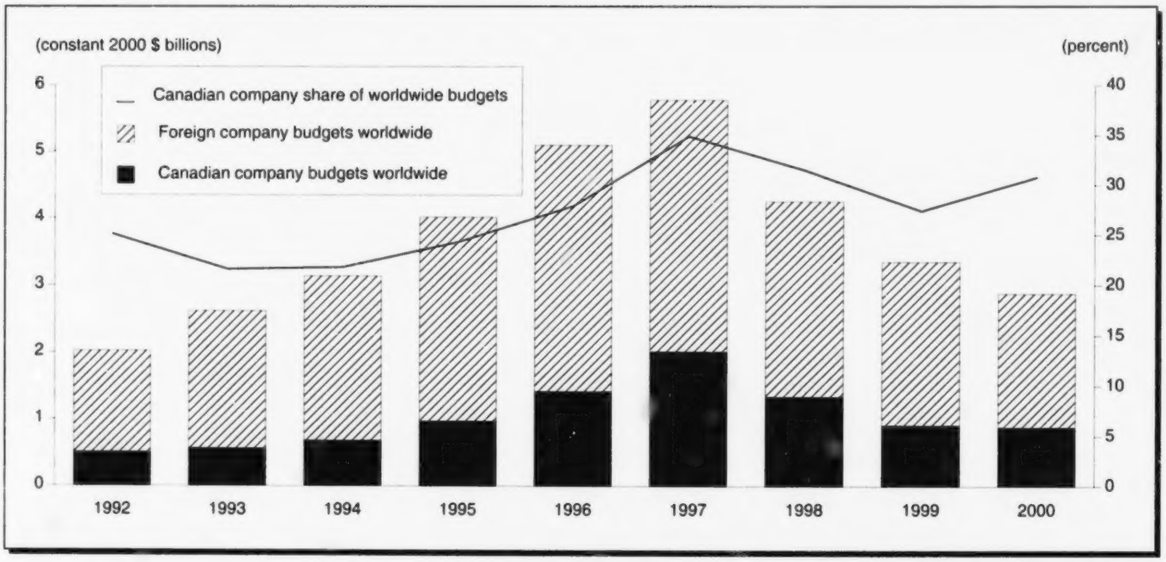
Although, on a company-by-company basis, there can be significant variations between budgets and expenditures, aggregate exploration budgets generally provide a reliable estimate of actual sums spent worldwide in the field. In the case of the larger Canadian companies, actual expenditures in 1999 were about 7% lower than budgeted, roughly the same departure as in the previous year.[4]

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 6300 properties (Figure 3) located in Canada or in more than 100 other countries around the world.[5] Most of this portfolio is at the early exploration stage of the mineral development cycle.

LARGER-COMPANY EXPLORATION MARKET IN CANADA

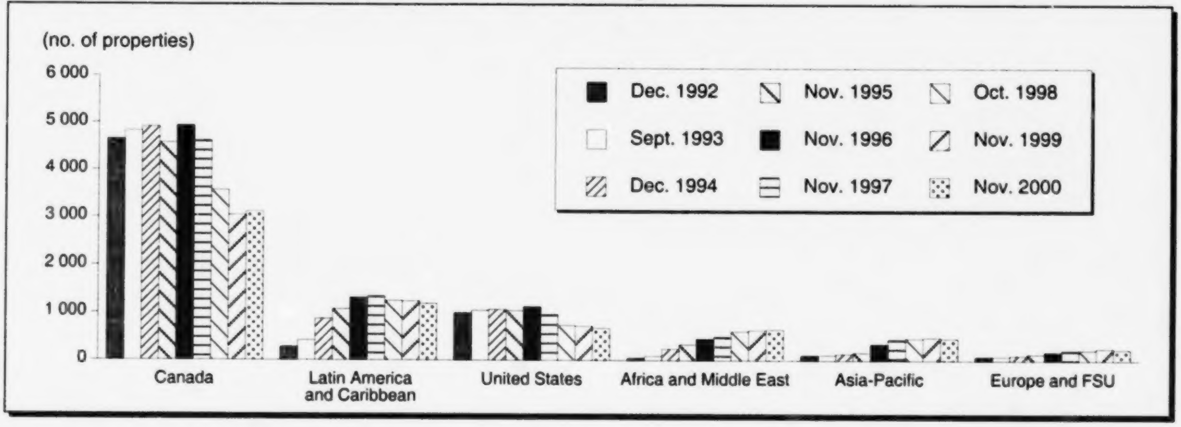
In 2000, the larger-company mineral exploration market in Canada was valued at almost $400 million, up by $35 million, or 10% from about $360 million in 1999 (Figure 4). The balance of the Canadian market is held by companies with worldwide exploration budgets of less than $4.4 million, the activities of which are not addressed specifically here. Canada and, to a lesser extent, New Caledonia, Brazil and South Africa are among the few countries where a significant increase in exploration activity was expected to occur from 1999 to 2000. Canada ranks second, after Australia, in terms of countries where the global

Figure 2
Exploration Budgets of the World's Larger Companies, by Origin, 1992-2000
Companies with Worldwide Budgets of at Least $4.4 Million in 2000 for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4.4 million in 2000 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 3
Canadian Mineral Property Portfolio Worldwide, by Region, 1992-2000
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1992-1997 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.
Note: The decrease in properties in Canada after 1997 is due mainly to the implementation of database features that make it possible to exclude many inactive properties.

mineral exploration industry is the most active. Canada has held that position since 1992.

In 2000, 53 of the world's larger domestic-based or foreign-based companies planned to explore for minerals in Canada. As a result, almost 14% of the exploration efforts of all of the world's larger companies were destined for Canada (Figure 5), up from about 11% during each of the previous three years. Prior to the large increase in exploration activity that occurred in developing countries starting in the early 1990s, the proportion of worldwide exploration activity taking place in Canada stood at 18%. At the end of 2000, there were more than 3100 mineral properties with recent exploration activity in this country (Figure 3).[6]

In 2000, 33 of the larger Canadian-based companies allocated, in total, almost $265 million for exploration in Canada, up from about $250 million in 1999. For the first year since 1994, Canadian companies planned to spend more on mineral exploration in Canada than in all of Latin America.

The larger Canadian-based companies control two thirds of the larger-company market in Canada. The only other countries where domestic companies control more than half of the larger-company market for mineral exploration are Australia, Japan and South Africa. In 1992, Canadian-based companies controlled 80% of the larger-company market in Canada but, with increasing globalization, their share has fallen gradually as foreign-based companies have increased their investment in this country. Since the early 1990s the share of the exploration market controlled by the larger domestic firms has also fallen gradually in the United States and Australia. Still, Canada remains the country where Canadian-based companies conduct, by far, the most mineral exploration (Figure 6).

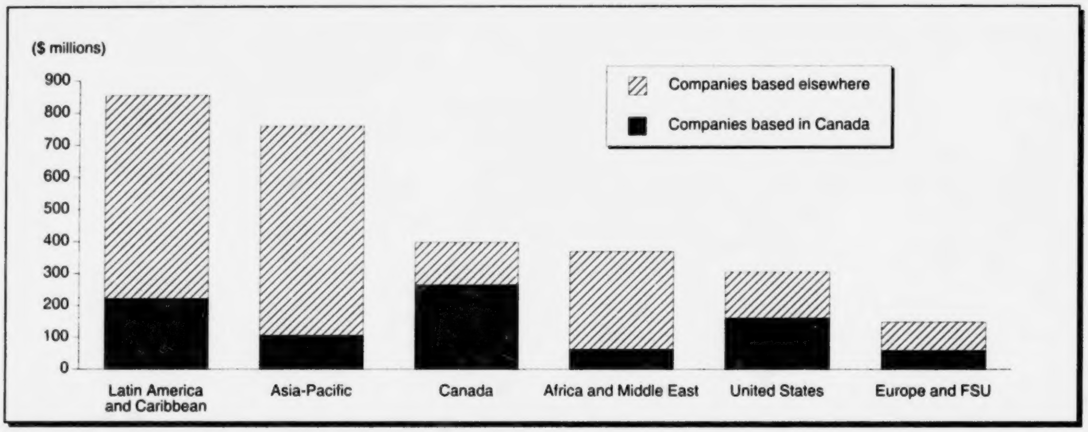
During 2000, 20 of the larger foreign-based companies planned to spend, in total, over $130 million on mineral exploration in Canada (Figure 5). This represents one third of all activity planned for this country. Compared with the previous year, the budgets of foreign-based companies for Canada increased by more than $32 million in 2000.

In 2000, the larger foreign-based companies active in mineral exploration in Canada included: Ashton Mining Ltd., The Broken Hill Proprietary Company Limited (BHP), Normandy Mining Ltd., Pasminco Limited and WMC Limited, all based in Australia; Battle Mountain Gold Company, Echo Bay Mines Ltd., Freeport-McMoRan Copper & Gold Inc., Homestake Mining Company, Newmont Mining Corporation and Phelps Dodge Corporation, all based in the United States; Anglo American plc, AngloGold Limited, Billiton plc, Outokumpu Oyj and Rio Tinto plc, all based in Europe; Anglo American Platinum Corporation Limited, De Beers Consolidated Mines, Limited and Impala Platinum Holdings Limited, all based in South Africa; and the Mexican mining consortium, Grupo Mexico S.A. de C.V.

In 2000, De Beers had an estimated exploration budget for Canada of almost $50 million, the largest of

Figure 4
Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 2000

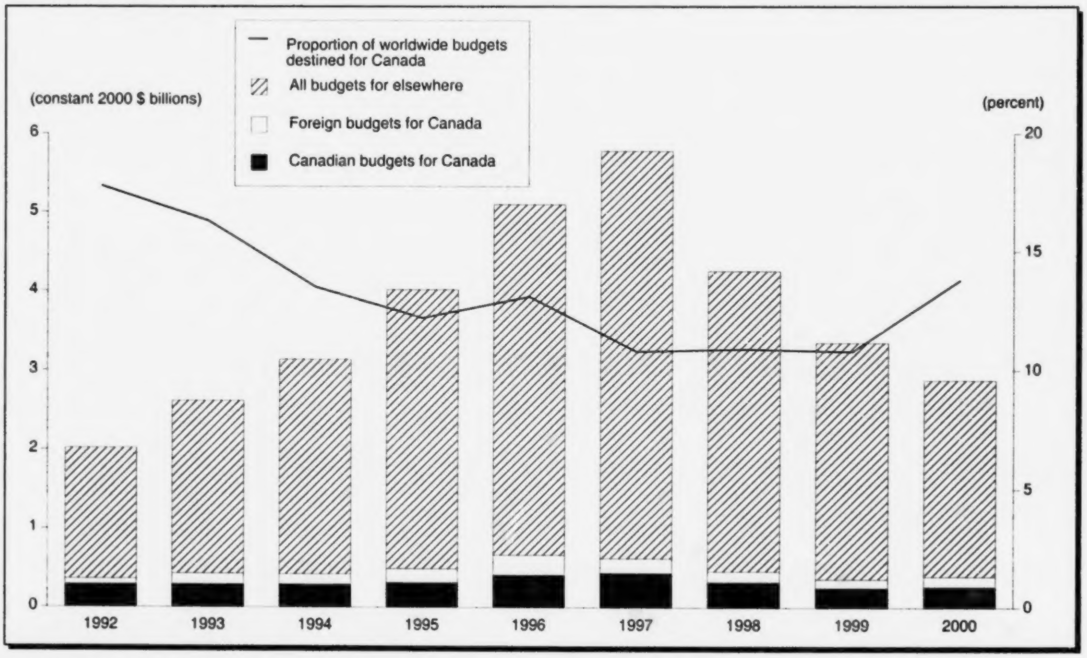
Companies with Worldwide Budgets of at Least $4.4 Million for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4.4 million in 2000 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

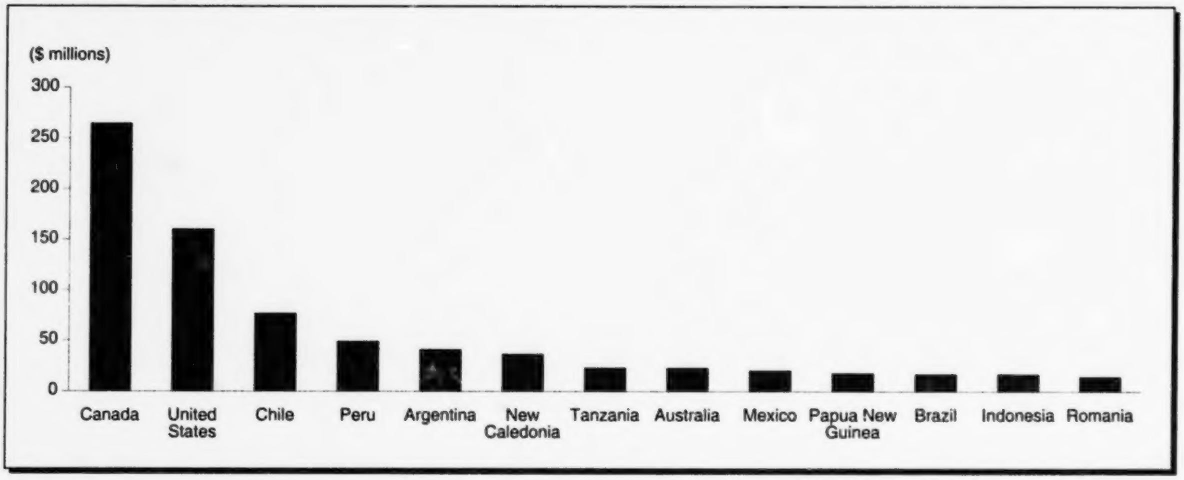
Figure 5
Exploration Budgets of the World's Larger Companies for Canada and Elsewhere, 1992-2000

Companies with Worldwide Budgets of at Least $4.4 Million in 2000 for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4.4 million in 2000 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 6
Exploration Budgets of the Larger Canadian-Based Companies, 2000 – Countries Accounting for 90% of Canadian Budgets
Companies with Worldwide Budgets of at Least $4.4 Million for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4.4 million in 2000 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

all domestic and foreign companies operating in this country. Grupo Mexico's exploration budget for Canada is the result of its takeover of ASARCO Incorporated, which planned to spend almost $3 million looking for base metals in this country.

LARGER CANADIAN-BASED COMPANIES ABROAD

In 2000, the larger Canadian-based companies planned to spend more than $620 million on mineral exploration outside Canada (Figure 4), down by 6% from the more than $665 million they had planned to spend in 1999. About 70% of their worldwide budgets for 2000 were allocated to programs abroad. Their foreign programs, as a proportion of all of their programs, peaked at over 78% in 1997. In 1992, that proportion was only slightly more than 40%.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of over 3200 mineral properties located abroad (Figure 3). Foreign properties represent slightly more than half of the total mineral property portfolio held by these companies, up from about 25% in 1992. Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, about 30 other nations, spread across the globe, account for most of the balance of their mineral property portfolio held abroad (Figure 7).

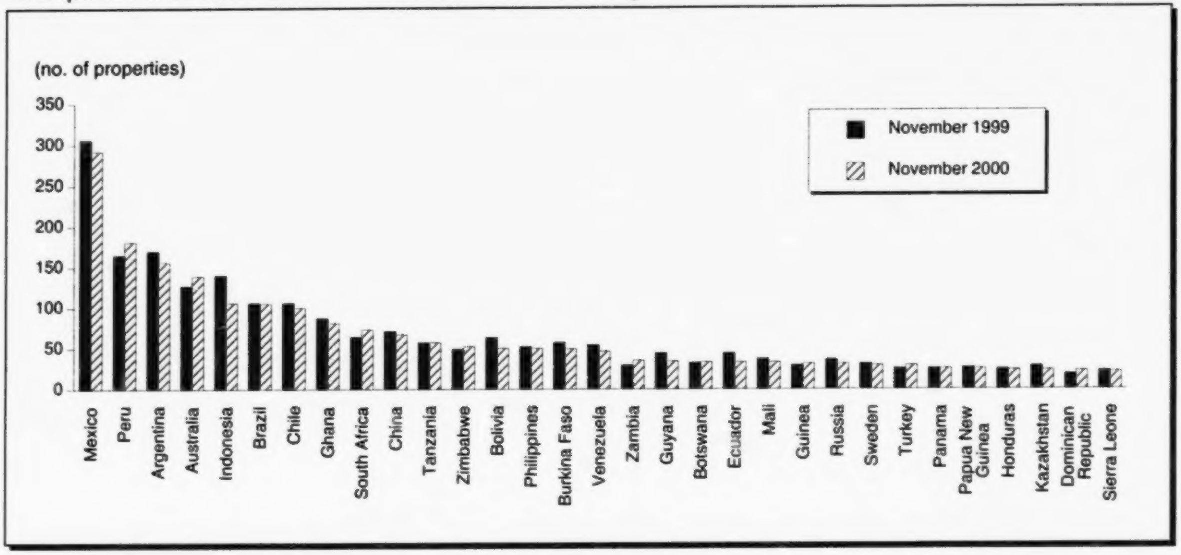
Canadian companies have interests in over 200 mines, smelters, refineries, plants under construction or projects awaiting the results of a final production feasibility study in almost 60 foreign countries (Table 1). They also have hundreds of other projects at the early stages of exploration in these countries, and in more than 40 others. The activities of Canadian mining companies in Canada and abroad have fostered the development in this country of over 2200 suppliers of specialized mining goods and services.[7]

United States

In 2000, the larger-company mineral exploration market in the United States was valued at over $300 million (Figure 4), or about 11% of the $2.9 billion larger-company market worldwide. In spite of general global retrenchment, 17 of the larger Canadian-based companies planned to spend, in total, about $160 million in the United States, only about 6% less than in 1999.

Companies based in most countries considerably reduced their exploration programs for the United States in recent years while those based in Canada increased theirs. As a result, the share of the larger-company exploration market held by Canadian-based

Figure 7
Canadian Mineral Property Portfolio Abroad, 1999 and 2000 – Countries Accounting for 80% of Canadian Holdings Located Outside the United States in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on InfoMine db, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

companies in the United States has grown to over 50%. Canadian-based companies have increased their share of the exploration market in the United States almost every year since the early 1990s. The United States ranks second after Canada in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

Canadian companies planned to spend almost $80 million more than U.S. companies in the United States during 2000. American companies have budgeted decreasing amounts for mineral exploration in their country most years since the early 1990s. Although American companies accounted for almost 60% of the value of all exploration programs in their country in 1992, they accounted for only 27% in 2000.

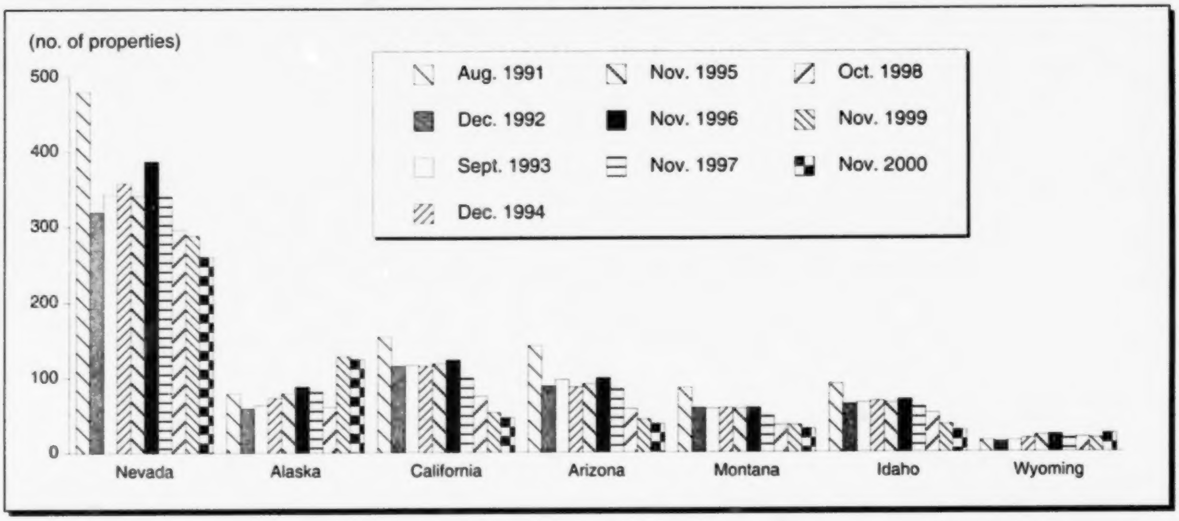
In late 2000, companies of all sizes listed on Canadian stock exchanges held about 675 mineral properties in the United States (Figure 3). They had projects located in 22 states, concentrated mainly in the western part of the country in Nevada, Alaska, California, Arizona, Montana, Idaho, Wyoming, Colorado, Washington, Utah and South Dakota (Figure 8). Nevada alone accounted for more than 250 of their mineral properties, or almost 40% of the total Canadian portfolio in the United States.

Although Canadian companies have considerably expanded their activities in Latin America, Africa and Asia since the early 1990s (Figure 3), the United States is likely to remain, for the foreseeable future, the foreign country where they hold their largest portfolio of mineral properties. At the end of 2000, the United States accounted for over 20% of all properties held abroad by companies of all sizes listed on Canadian stock exchanges.

Of all the Canadian-based companies, Placer Dome Inc., Teck Corporation, Cominco Ltd., Barrick Gold Corporation and Kinross Gold Corporation planned the largest mineral exploration programs in the United States during 2000. Together they planned to spend more than $135 million, equivalent to over 80% of the value of all Canadian programs for that country.

Placer Dome planned to spend about two thirds of its $44 million exploration budget for the United States at the Getchell gold mine in Nevada. This budget was the largest of all domestic and foreign companies operating in that country in 2000. Teck planned to spend much of its $28 million budget for the United States at the Pogo gold deposit in Alaska. Cominco planned to spend a good portion of its $25 million American budget in proximity to the Red Dog zinc-lead-silver mine in Alaska and at the Pend Oreille zinc-lead deposit in Washington State. Barrick planned to spend much of its $25 million budget for the United States on further exploration for gold at the Goldstrike mine, the Pinson mine, at the Rossi

Figure 8
Canadian Mineral Property Portfolio in the United States, 1991-2000 – States Accounting for 80% of Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

deposit and the Dee property, all in Nevada. Kinross planned to spend much of its $13 million American budget at or near the Fort Knox gold mine in Alaska.

Latin America and the Caribbean

In 2000, the larger-company mineral exploration market in Latin America and the Caribbean was valued at over $850 million (Figure 4), or almost 30% of the $2.9 billion larger-company market worldwide.

During 2000, the larger Canadian-based companies planned to spend over $220 million there, down by $60 million, or roughly 20%, compared with 1999. After Canada, Latin America has become the region of the world where Canadian companies are the most active in mineral exploration. However, from 1995 to 1999, Canadian companies spent more on exploration in that region than in Canada. In 2000, Canadian companies held slightly more than one quarter of the larger-company market in Latin America and the Caribbean, ranking a close second to companies based in that region.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held interests in almost 1200 mineral properties in Latin America and the Caribbean. Since 1996, the total number of mineral properties held by Canadian companies in the region has exceeded the number held in the United States (Figure 3).

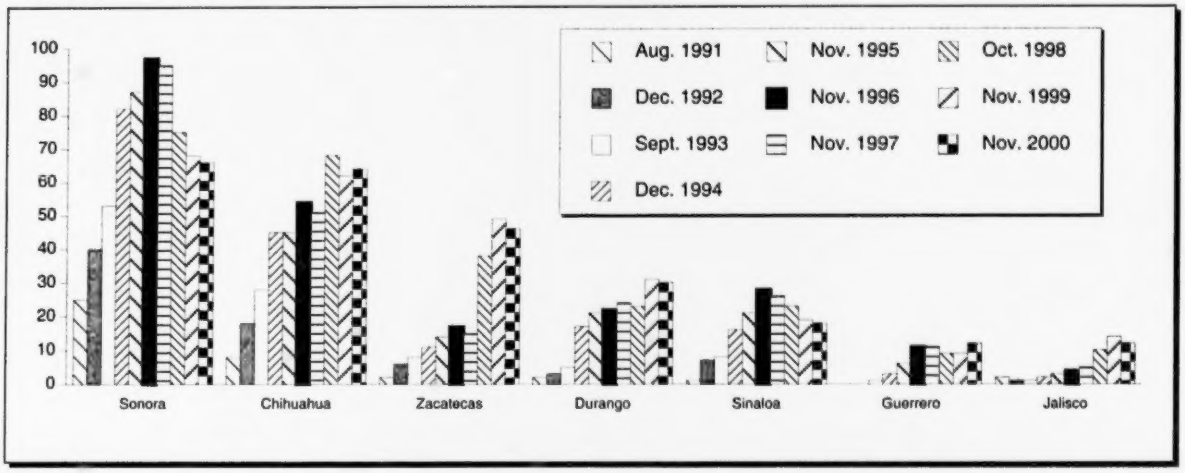
Mexico

In 2000, the larger-company mineral exploration market in Mexico was valued at almost $120 million, or 4% of the $2.9 billion larger-company market worldwide. Eleven of the larger Canadian-based companies planned to spend, in total, $20 million in that country, equivalent to almost 17% of the market. Mexico ranks fourth in Latin America and ninth in the world in terms of countries where Canadian companies are the most active (Figure 6).

During 1994, there was a significant increase in the mineral property portfolio held in Mexico by companies of all sizes listed on Canadian stock exchanges. At the end of 2000, these companies held interests in almost 300 properties in 20 of the country's 31 states and district (Figure 9).

Teck and Noranda Inc. planned the largest Canadian exploration programs in Mexico during 2000. Teck planned to spend a good portion of its $10 million budget for Mexico to study the feasibility of bringing into production the San Nicholas copper-zinc deposit and on delineating reserves at the Los Filos gold deposit. Noranda planned to spend $4.7 million on grassroot exploration for base metals at the El Gordo, Lobo 6, Gavilanes, Aire Libre, La Joya and other properties.

Figure 9
Canadian Mineral Property Portfolio in Mexico, 1991-2000 – States Accounting for 80% of Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

South America

In 2000, the larger-company mineral exploration market in South America was valued at over $680 million, almost one quarter of the $2.9 billion larger-company market worldwide. Twenty-four of the larger Canadian-based companies planned to spend $185 million in total in the region, which represents 27% of the market there. Canadian companies held the dominant share of the market in both Chile and Argentina.

Chile is the South American country where Canadian-based companies conduct the largest portion of their exploration programs (Figure 6). It ranks third in the world in terms of countries where Canadian companies are the most active in exploration. In 2000, Barrick planned to spend $35 million in Chile, equivalent to almost 17% of the value of all exploration programs planned for that country. The company planned to allocate most of its budget there to increase reserves on the Pascua portion of the Pascua-Lama gold-silver deposit, which straddles the Chile-Argentina border. In addition, Barrick planned to spend most of its $32 million budget for Argentina on the Lama portion of the Pascua-Lama deposit. The exploration programs planned by Barrick for Chile and Argentina were the largest in both of these countries.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held more than 750 mineral properties throughout South America. They held about 180 properties in Peru, more than 150 in Argentina, more than 100 in each of Brazil and Chile, and about 50 in each of Bolivia and Venezuela (Figure 10).

Central America

In 2000, the larger-company mineral exploration market in Central America was valued at about $7 million, or less than 1% of the $2.9 billion larger-company market worldwide. Two of the larger Canadian-based companies were expected to conduct about one quarter of all exploration programs in the region.

Breakwater Resources Ltd. planned to spend roughly $2 million at the El Mochito zinc-lead-silver mine in Honduras. Although this is a relatively small program, it represents more than 40% of the larger-company mineral exploration market in that country.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held about 100 mineral properties throughout Central America. They held 20 or more in each of Panama and Honduras (Figure 11).

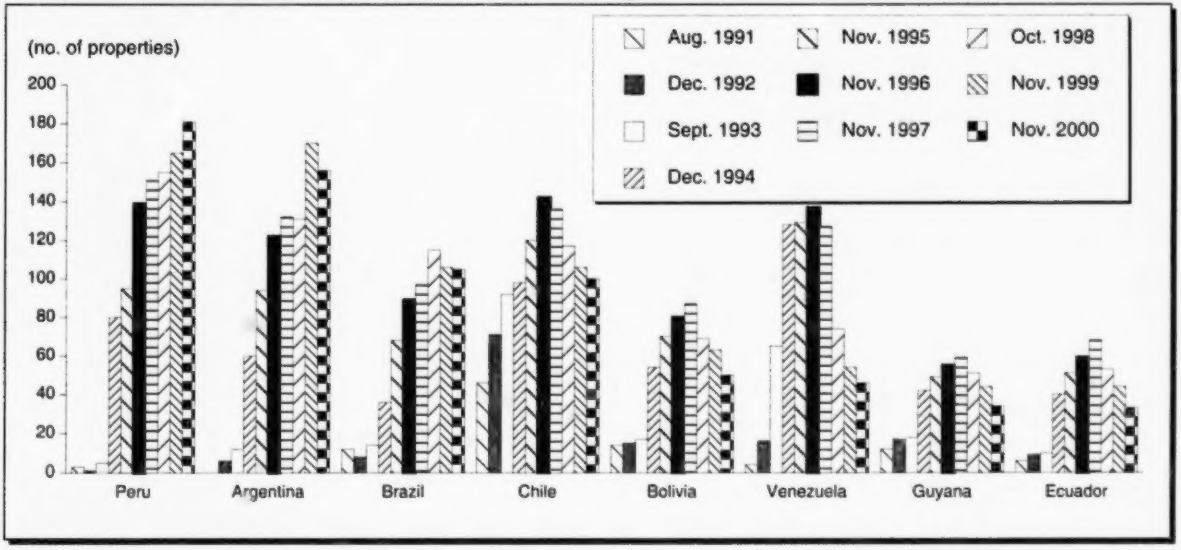
Caribbean

In 2000, the larger-company mineral exploration market in the Caribbean was valued at about $6 million, or less than 1% of the $2.9 billion larger-company market worldwide. Northern Orion

Figure 10

Canadian Mineral Property Portfolio in South America, 1991-2000 – Countries Accounting for 90% of Canadian Holdings in 2000

Companies of all Sizes Listed on Canadian Stock Exchanges

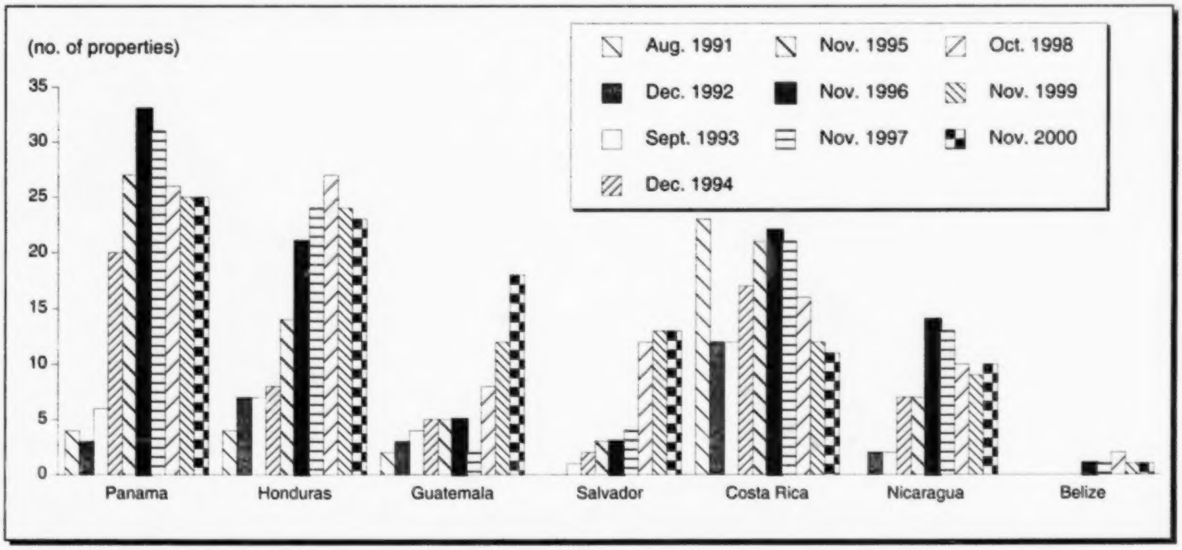


Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 11

Canadian Mineral Property Portfolio in Central America, 1991-2000

Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Explorations Ltd. is the only larger Canadian-based company that reported an exploration program for the Caribbean. The company planned to spend $0.3 million in Cuba on a study of the feasibility of bringing the Mantua copper-gold deposit into production.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in the Caribbean, most of them in the Dominican Republic and Cuba (Figure 12).

Europe and the Former Soviet Union

In 2000, the larger-company mineral exploration market in Europe and the Former Soviet Union (FSU) was valued at almost $150 million (Figure 4), or slightly more than 5% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $60 million in the region, equivalent to almost 40% of the market. At the end of 2000, companies of all sizes listed on Canadian stock exchanges held almost 240 mineral properties in Europe and the FSU (Figure 3).

Western Europe

In 2000, the larger-company mineral exploration market in western Europe was valued at almost $70 million, or slightly more than 2% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend more than $20 million there, equivalent to more than one third of the market.

Canadian-based companies held the dominant share of the market in two countries of western Europe. In Greenland, Crew Development Corporation planned to spend almost $4 million on advanced exploration at the Nalunaq gold deposit, the largest program in that country. Crew also planned to spend $1.5 million at the Røros zinc-copper complex in Norway.

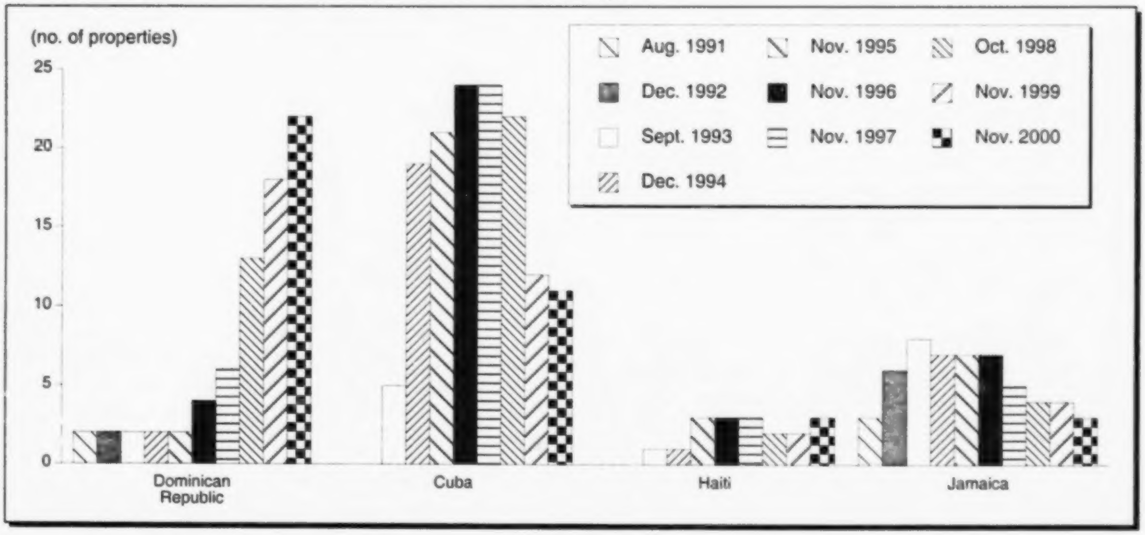
At the end of 2000, companies of all sizes listed on Canadian stock exchanges held more than 100 mineral properties in western Europe. They held almost 30 in Sweden and more than 10 in each of Portugal, Greenland and Spain (Figure 13).

Eastern Europe

In 2000, the larger-company mineral exploration market in eastern Europe was valued at almost $30 million, or less than 1% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend more than $20 million there, equivalent to 85% of the market.

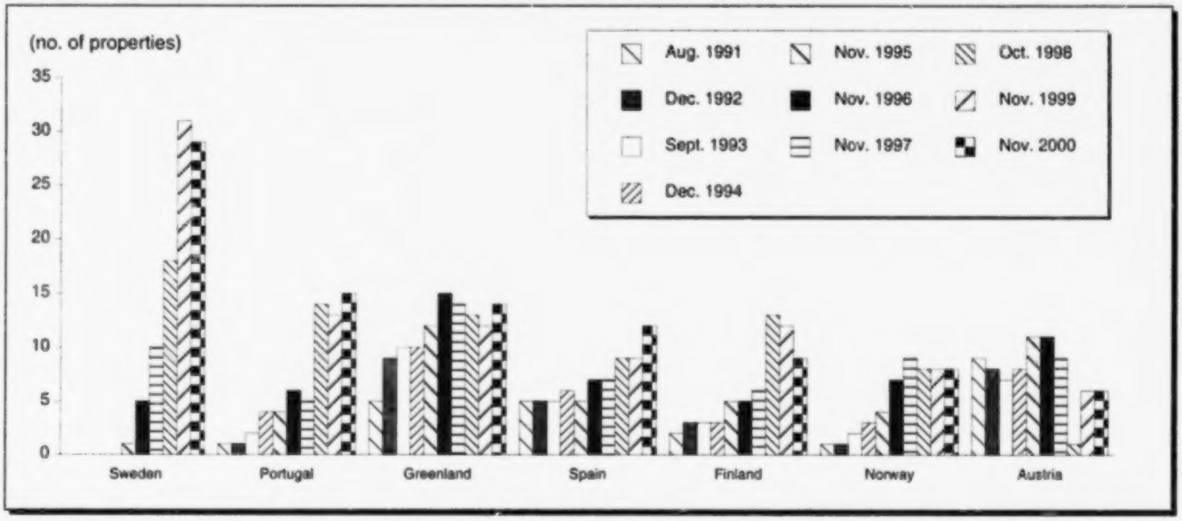
Canadian-based companies held the dominant share of the market in two countries of eastern Europe. In Romania, Gabriel Resources Limited planned to

Figure 12
Canadian Mineral Property Portfolio in the Caribbean, 1991-2000 – Countries With Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 13
Canadian Mineral Property Portfolio in Western Europe, 1991-2000 – Countries Accounting for 90% of Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

spend over $14 million, about 70% of it to study the feasibility of bringing the Rosia Montana gold-silver deposit into production, while in Turkey, Eldorado Gold Corporation planned to spend roughly $4 million on advanced exploration for gold.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held almost 70 mineral properties in eastern Europe. They held almost 30 in Turkey (Figure 14).

Former Soviet Union

In 2000, the larger-company mineral exploration market in the countries of the FSU was valued at almost $40 million,[8] or slightly more than 1% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $6 million in these countries.

At the end of 2000, companies of all sizes listed on Canadian-based stock exchanges held interests in almost 70 mineral properties in six countries of the FSU (Figure 15).

Russia is the country of the FSU where the larger Canadian-based companies are the most active. In 2000, they planned to spend about $5 million on exploration there, equivalent to about 30% of the market. Kinross, whose budget for Russia was the largest of all larger companies operating there, planned to spend almost $3 million, mainly at or in the vicinity of the Kubaka gold-silver mine. The number of properties held in Russia by companies of all sizes listed on Canadian stock exchanges increased significantly starting in 1996 and now stands at over 30.

Africa and the Middle East

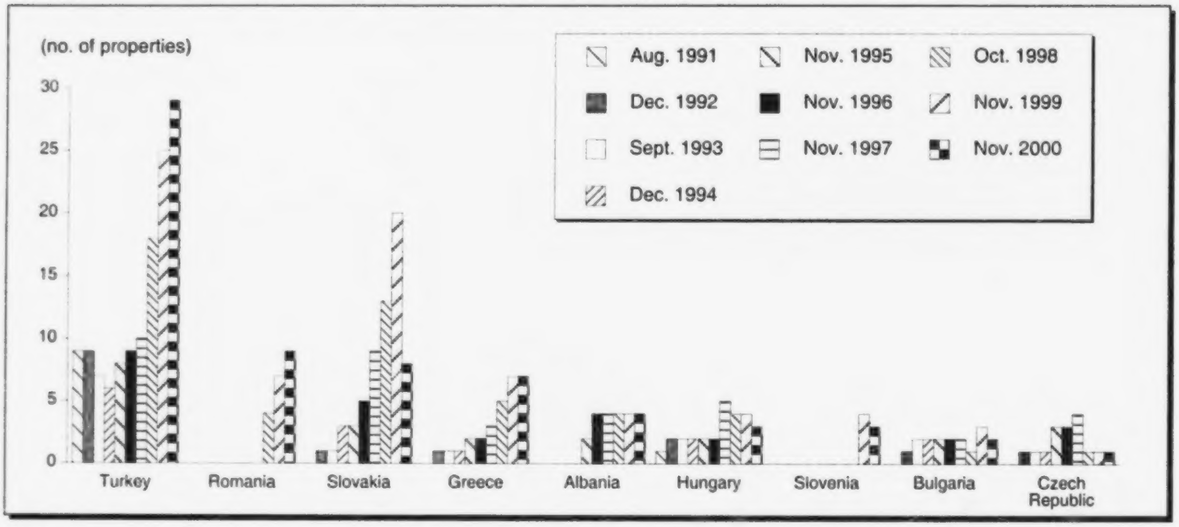
In 2000, the larger-company mineral exploration market in Africa and the Middle East was valued at almost $370 million (Figure 4), or almost 13% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend more than $60 million in Africa, equivalent to almost 17% of the market on that continent.

Africa

In 2000, the larger-company mineral exploration market in Africa was valued at almost $365 million (Figure 4), or almost 13% of the $2.9 billion larger-company market worldwide.

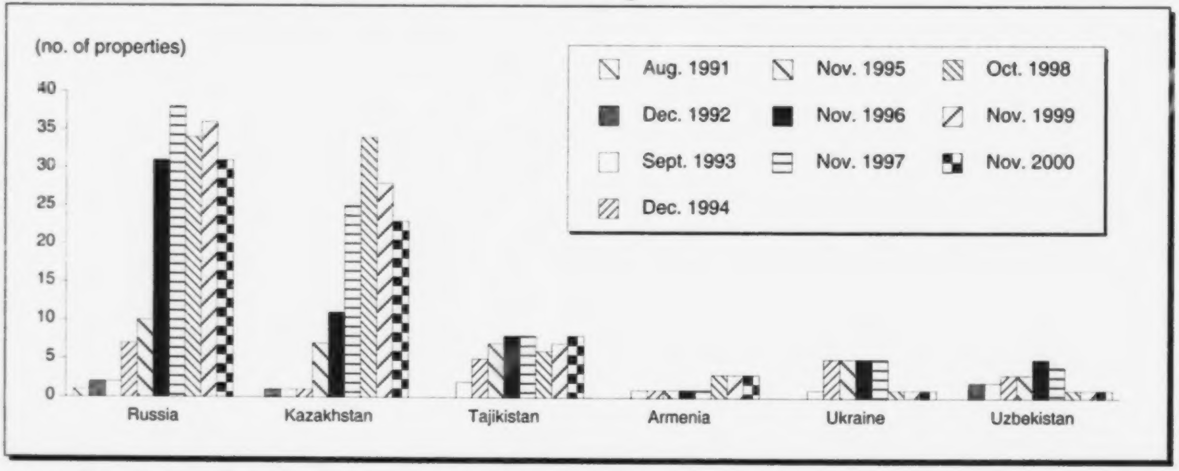
The larger Canadian-based companies were expected to finance the largest share of the mineral exploration programs in four countries of Africa: in Burkina Faso, SEMAFO Inc. planned to spend more than $4 million on grassroots exploration at the Mana property; in Niger, SEMAFO also planned to spend almost $3 million for advanced exploration at

Figure 14
Canadian Mineral Property Portfolio in Eastern Europe, 1991-2000 – Countries With Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 15
Canadian Mineral Property Portfolio in the Former Soviet Union, 1991-2000 – Countries with Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

the Libiri gold deposit; in Senegal, IAMGOLD Corporation planned to spend over $1.5 million on grassroots exploration for gold at the Bambadji and Daorala-Boto properties; and in Tanzania, Barrick planned to spend almost $15 million looking for gold, more than half of it at the Bulyanhulu mine.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held interests in almost 640 mineral properties in 39 countries on the African continent. They held interests in over 80 properties in Ghana, in over 70 in South Africa, and in 50 or more in each of Tanzania, Zimbabwe and Burkina Faso (Figure 16).

Middle East

In 2000, the larger-company mineral exploration market in the Middle East was valued at about $5 million. The larger Canadian-based companies planned to spend only $0.1 million there, equivalent to about 2% of the market in that region.

Asia-Pacific

In 2000, the larger-company mineral exploration market in Asia-Pacific was valued at almost $760 million (Figure 4), or more than one quarter of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $100 million in the region, equivalent to 14% of the market there. Canadian budgets for Asia-Pacific were almost twice as large as in 1999.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held interests in over 460 mineral properties in Asia-Pacific (Figure 3).

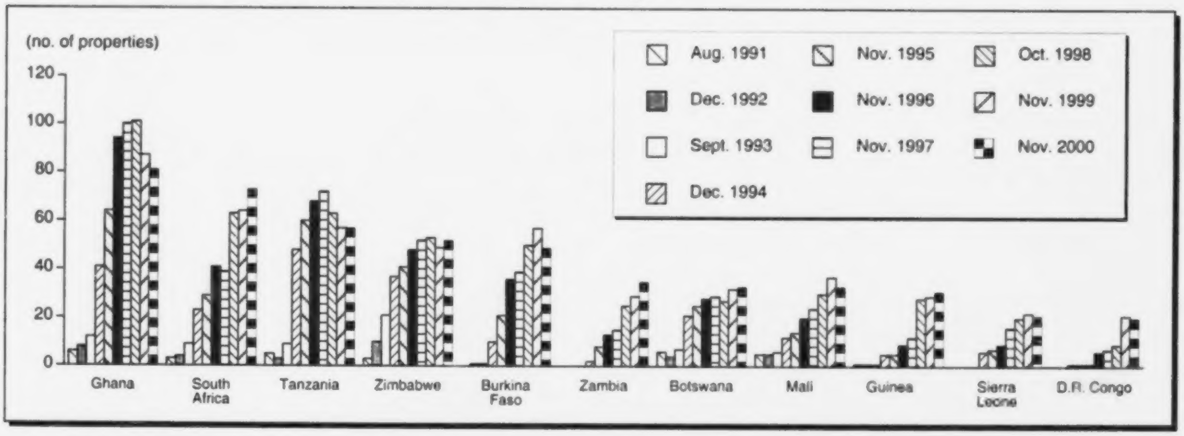
Southeast Asia

In 2000, the larger-company mineral exploration market in Southeast Asia was valued at over $200 million, or slightly more than 7% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $40 million in the region, equivalent to more than 20% of the market there.

In Indonesia, Weda Bay Minerals Inc. planned to spend over $7 million to study the feasibility of bringing the Halmahera Island nickel-cobalt deposit into production. In Papua New Guinea, Madison Enterprises Corp. planned to spend $15 million on advanced exploration at the Mount Kare gold-silver deposit. In the Philippines, Crew planned to spend more than $4 million on advanced exploration at the Mindoro lateritic nickel-cobalt deposit. In Vietnam, Falconbridge Limited planned to spend $1 million at the Ban Phuc nickel-copper deposit.

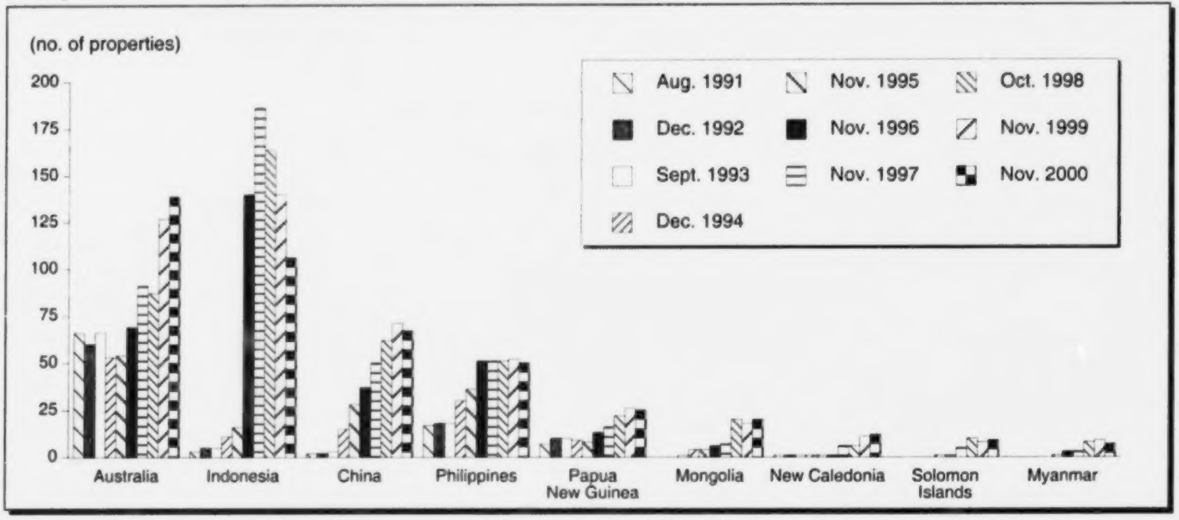
At the end of 2000, companies of all sizes listed on Canadian stock exchanges held over 200 mineral properties in Southeast Asia. They held over 100 in Indonesia and more than 50 in the Philippines (Figure 17).

Figure 16
Canadian Mineral Property Portfolio in Africa, 1991-2000 – Countries Accounting for 75% of Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 17
Canadian Mineral Property Portfolio in Asia-Pacific, 1991-2000 – Countries Accounting for 95% of Canadian Holdings in 2000
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

East Asia

In 2000, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia, North Korea, South Korea and Taiwan, was valued at almost $40 million,[9] or slightly more than 1% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $5 million there, equivalent to almost 13% of the market.

Since 1993, there has been considerable Canadian interest in the mineral potential of China. In 2000, Placer Dome and Teck each planned to spend about $0.7 million there. In late 2000, companies of all sizes listed on Canadian stock exchanges held interests in almost 70 mineral properties in that country (Figure 17).

In South Korea, Ivanhoe Mines Ltd. planned to spend about $1.5 million on grassroots exploration for base metals. In Mongolia, Cameco Corporation planned to spend almost $2 million on grassroots exploration for gold at the Sharingol concession.

South Pacific

In 2000, the larger-company mineral exploration market in the South Pacific was valued at over $500 million, or over 17% of the $2.9 billion larger-company market worldwide. Australia accounted for 90% of that market. The larger Canadian-based companies planned to spend almost $60 million in the region, three times as much as in 1999.

In New Caledonia, Falconbridge planned to spend over $36 million for advanced exploration at the Koniambo lateritic nickel deposit. This budget is among the largest for a single Canadian project abroad. In Australia, Placer Dome planned to spend over 70% of its more than $7 million budget for that country looking for additional gold at the Granny Smith mine and at the Kidston mine. Noranda planned to spend a good portion of its more than $6 million budget for Australia at the Lady Loretta zinc-lead-silver deposit.

At the end of 2000, companies of all sizes listed on Canadian stock exchanges held almost 170 properties in the South Pacific, of which over 80% were located in Australia (Figure 17).

South Asia

In 2000, the larger-company mineral exploration market in South Asia, which includes India, Pakistan and Sri Lanka, was valued at about $13 million, or less than 1% of the $2.9 billion larger-company market worldwide. The larger Canadian-based companies reported no exploration programs for that region.

SUMMARY AND OUTLOOK

In 2000, Canadian-based companies planned to conduct mineral exploration programs around the world valued at roughly $900 million. This is equivalent to more than 30% of all of the activity planned worldwide. Almost 14% of the world's mineral exploration activity was expected to occur in Canada, compared with about 11% in each of the previous three years. Canada is one of the few countries where exploration activity was expected to increase significantly from 1999 to 2000. For the first year since 1994, Canadians planned to conduct more exploration in Canada than in all of Latin America.

Also in 2000, Canadian companies further increased their share of the exploration market in the United States. They planned to undertake over 50% of all exploration activity there. Furthermore, they planned to conduct the largest share of exploration programs not only in Canada, but also in South America, the Caribbean and eastern Europe. Although Canadian companies have diversified their portfolio of mineral projects to well over 100 countries, Canada remains the country where they are, by far, the most active.

Exploration finance markets remain depressed and mineral commodity prices are relatively low, such that a return to the record levels of exploration programs carried out around the world in the late 1990s is not in sight. Many of the smaller companies are inactive because of a lack of funds. Mergers and acquisitions are commonplace.

Although Canadian companies tend to have smaller exploration budgets than those of other developed countries, they are considerably more numerous than companies based elsewhere. As a result, companies based in Canada are likely to continue, for the foreseeable future, to dominate mineral exploration worldwide.

REFERENCES

[1] All currencies in this review are expressed in Canadian dollars unless otherwise indicated.

[2] Most of the data on the larger-company mineral exploration market worldwide are based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by the Metals Economics Group, Halifax, Nova Scotia (tel. [902] 429-2880).

[3] Keith Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp. (tel. [613] 995-4577).

[4] For more information on various aspects of the relationship between exploration budgets and exploration expenditures for the larger Canadian companies, see André Lemieux, "Canada's Global Mining Presence," in the 1998 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.1 and 7.2; see also André Lemieux, "Canada's Global Mining Presence," in the 1999 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada Ottawa, pp. 7.1 and 7.3 (http://www.nrcan.gc.ca/mms/cmy/content/1998/08.pdf and http://www.nrcan.gc.ca/mms/cmy/content/08.pdf, respectively).

[5] Most of the data for 1991 through 1997 on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges are derived from *MIN-MET CANADA*; for 1998 through 2000, they are derived from *InfoMine db*. These databases are products of Robertson Info-Data Inc., Vancouver, British Columbia (tel. (604) 683-2037).

[6] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in early 1997, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 8.9 and 8.11-8.22 (http://www.nrcan.gc.ca/mms/cmy/content/1996/08.pdf).

[7] For a discussion of the global market for mining goods and services and the role played by Canadian companies, see André Lemieux, *Canadian Suppliers of Mining Goods and Services: Links Between Canadian Mining Companies and Selected Sectors of the Canadian Economy*, Natural Resources Canada, Ottawa, September 2000, 84 pp. (http://www.nrcan.gc.ca/mms/pubs/services-mines-e.pdf).

[8, 9] The mineral exploration market in certain regions of the world is probably underestimated because there are few data available on the extent of exploration programs undertaken by some state agencies.

Notes: (1) Information in this review was current as at July 2001. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. SELECTED PRODUCTION AND OTHER ADVANCED MINERAL DEVELOPMENT PROJECTS ABROAD IN WHICH COMPANIES BASED IN CANADA HAVE AN INTEREST

Country	Project	Canadian Participants	Products	Status
Angola	Camafuca	SouthernEra Resources Limited	Diamonds	Feasibility
	Luo	DiamondWorks Ltd.	Diamonds	Suspended
	Yetwene	DiamondWorks Ltd.	Diamonds	Suspended
Argentina	Alumbrera, Bajo de la	Rio Algom Limited	Copper, gold	Production
	El Pachón	Cambior Inc.	Copper	Feasibility
	Lama (Pascua-Lama)	Barrick Gold Corporation	Gold, silver	Feasibility
Armenia	Ararat	First Dynasty Mines Ltd.	Gold	Production
	Meghradzor	First Dynasty Mines Ltd.	Gold	Construction
	Zod	First Dynasty Mines Ltd.	Gold	Feasibility
Australia	Bounty	Viceroy Resource Corporation	Gold	Production
	Carosue Dam	Teck Corporation	Gold	Production
	Ely	Alcan Inc.	Aluminum	Production
	Emily Ann	LionOre Mining International Ltd.	Nickel	Construction
	Gladstone (refinery)	Alcan Inc.	Aluminum	Production
	Gove	Alcan Inc.	Aluminum	Production
	Granny Smith	Placer Dome Inc.	Gold	Production
	Kalgoorlie	Barrick Gold Corporation	Gold	Production
	Kidston	Placer Dome Inc.	Gold, silver	Production
	Magellan	Ivernia West Inc.	Lead	Feasibility
	Mount Cuthbert	Summo Minerals Corporation	Copper	Production
	Osborne	Placer Dome Inc.	Gold, copper	Production
	Savage River	Ivanhoe Mines Ltd.	Iron	Production
	Tarmoola	Teck Corporation	Gold	Production
	Thunderbox	Lion Ore Mining International Ltd.	Gold	Feasibility
	Yilgarn	Barrick Gold Corporation	Gold	Production
Bolivia	Amayapampa	Vista Gold Corp.	Gold	Feasibility
Botswana	Phoenix (Tati)	LionOre Mining International Ltd.	Nickel, copper	Production
	Selkirk (Tati)	LionOre Mining International Ltd.	Nickel, copper	Production
Brazil	Alumar (refinery)	Alcan Inc.	Aluminum	Production
	Aratu (smelter)	Alcan Inc.	Aluminum	Production
	Brasília	TVX Gold Inc.	Gold	Production
	Crixás	TVX Gold Inc.	Gold	Production
	Ouro Preto (refinery)	Alcan Inc.	Aluminum	Production
	Ouro Preto (smelter)	Alcan Inc.	Aluminum	Production
	São Bento	Eldorado Gold Corporation	Gold	Production
	Trombetas	Alcan Inc.	Aluminum	Production
Chile	Altonorte (smelter)	Noranda Inc.	Copper, sulphuric acid	Production
	Andacollo Copper	Aur Resources Inc.	Copper, gold	Production
	Cerro Casale (Aldebaran)	Placer Dome Inc., Bema Gold Corporation, Arizona Star Resource Corp.	Gold, copper, silver	Feasibility
	Cerro Colorado	Rio Algom Limited	Copper	Production
	Collahuasi	Falconbridge Limited	Copper	Production
	El Indio	Barrick Gold Corporation	Copper, gold, silver	Production
	El Toqui	Breakwater Resources Ltd.	Zinc, gold, silver, copper, lead	Production
	Guanaco	Kinross Gold Corporation	Gold, silver	Production
	La Coipa	Placer Dome Inc., TVX Gold Inc.	Gold, silver	Production
	Lobo-Marte	Teck Corporation	Gold	Feasibility
	Lomas Bayas	Boliden Limited	Copper	Production
	Pascua (Pascua-Lama)	Barrick Gold Corporation	Gold, silver	Feasibility
	Quebrada Blanca	Aur Resources Inc.	Copper	Production
	Refugio	Bema Gold Corporation, Kinross Gold Corporation	Gold, silver	Production
	Zaldívar	Placer Dome Inc.	Copper	Production
China	Bamen Est	Goldpark China Limited	Gold	Production
	Crimson Hills	Goldpark China Limited	Gold	Production
	Fortune Mountain	Goldpark China Limited	Gold	Production
	Hucun	UNIREX Corporation	Copper, gold	Production
	Kunshun (refinery)	Inco Limited	Nickel	Production
	Qian Chang	UNIREX Corporation	Iron, copper, gold, siliver	Production
Costa Rica	Bellavista	Wheaton River Minerals Ltd.	Gold	Feasibility
Cuba	Mantua	Northern Orion Explorations Ltd.	Copper, gold	Feasibility
	Moa Bay	Sherritt International Corporation	Nickel, cobalt	Production
Democratic Republic of the Congo	Tenke Fungurume	Tenke Mining Corp.	Copper, cobalt	Feasibility
Dominican Republic	Falcondo	Falconbridge Limited	Nickel	Production
Ghana	Bonte (Jeni)	Akrokeri-Ashanti Gold Mines Inc.	Gold	Production
	Ghana Bauxite (GBC)	Alcan Inc.	Aluminum	Production
	Tarkwa	Repadre Capital Corporation	Gold	Production

TABLE 1. (cont'd)

Country	Project	Canadian Participants	Products	Status
Greece	Olympias	TVX Gold Inc.	Gold, zinc, lead, silver	Construction
	Skouries	TVX Gold Inc.	Gold, copper	Feasibility
	Stratoni	TVX Gold Inc.	Lead, zinc, silver	Production
Greenland	Nulanuq	Crew Development Corporation	Gold	Feasiblity
Guinea	Aredor	Trivalence Mining Corporation	Diamonds	Production
	Halco (CBG)	Alcan Inc.	Aluminum	Production
	Jean-Gobele	SEMAFO Inc.	Gold	Construction
Guyana	Omai	Cambior Inc.	Gold	Production
Honduras	El Mochito	Breakwater Resources Ltd.	Zinc, lead, silver	Production
	Vueltas del Rio	Geomaque Explorations Ltd.	Gold	Construction
India	Alupuram (smelter)	Alcan Inc.	Aluminum	Production
	Chandgad	Alcan Inc.	Aluminum	Production
	Hirakud (smelter)	Alcan Inc.	Aluminum	Production
	Lohardaga	Alcan Inc.	Aluminum	Production
	Muri (refinery)	Alcan Inc.	Aluminum	Production
	Utkal	Alcan Inc.	Aluminum	Feasibility
	Utkal (refinery)	Alcan Inc.	Aluminum	Feasibility
Indonesia	Cikidang	International Antam Resources Ltd.	Gold, silver	Production
	Halmahera	Weda Bay Minerals Inc.	Nickel, cobalt	Feasibility
	Soroako	Inco Limited	Nickel	Production
Ireland	Lisheen	Ivernia West Inc.	Zinc, lead	Production
Japan	Tokyo (refinery)	Inco Limited	Nickel	Production
Kazakhstan	Central Mukur	Eurasia Gold Corp.	Gold	Production
	Inkai (test mine)	Cameco Corporation	Uranium	Feasibility
	Myaly	Eurasia Gold Corp.	Gold	Production
Kenya	Kwale	Tiomin Resources Inc.	Titanium sands	Feasibility
Kyrgyzstan	Kumtor	Cameco Corporation	Gold	Production
Mali	Sadiola	IAMGOLD Corporation	Gold	Production
	Yatela	IAMGOLD Corporation	Gold	Production
Mexico	Avino	Avino Silver & Gold Mines Ltd.	Silver, copper, gold	Production
	La Colorada	Pan American Silver Corp.	Silver, gold, zinc, lead	Feasibility
	Magistral	Queenstake Resources Ltd.	Gold	Feasibility
	Paredones Amarillos	Viceroy Resource Corporation	Gold	Feasibility
	Pilares	Fording Inc.	Wollastonite	Production
	San Francisco	Geomaque Explorations Ltd.	Gold	Production
	San Martin	First Silver Reserve Inc.	Silver	Production
	San Nicholas	Teck Corporation, Western Copper Holdings Limited	Zinc, copper, gold, silver	Feasibility
Myanmar	Letpadaung	Ivanhoe Mines Ltd.	Copper	Feasibility
	Monywa (S&K)	Ivanhoe Mines Ltd.	Copper	Production
New Caledonia	Goro	Inco Limited	Nickel, cobalt	Feasibility
	Koniambo	Falconbridge Limited	Nickel	Feasibility
Nicaragua	El Limon	Black Hawk Mining Inc.	Gold	Production
Niger	Samira Hill	SEMAFO Inc.	Gold	Construction
Norway	Bjørnevatn	Ivanhoe Mines Ltd.	Iron	Financing
	Nikkelverk (refinery)	Falconbridge Limited	Nickel, copper, cobalt, silver, gold, platinum group metals, sulphuric acid	Production
	Norzinc (smelter and refinery)	Boliden Limited	Zinc, aluminum	Production
Papua New Guinea	Misima	Placer Dome Inc.	Gold, silver	Production
	Ok Tedi	Inmet Mining Corporation	Copper, gold	Production
	Porgera	Placer Dome Inc.	Gold, silver	Production
Peru	Acari	Dynacor Mines Inc.	Gold	Production
	Antamina	Noranda Inc., Teck Corporation	Copper, zinc, silver, molybdenum	Production
	Cajamarquilla (refinery)	Cominco Ltd.	Zinc, sulphuric acid	Production
	El Brocal (Tajo Norte)	Cominco Ltd.	Zinc, lead, silver	Production
	Huaron	Pan American Silver Corp.	Silver, zinc, lead, copper	Production
	Pierina	Barrick Gold Corporation	Gold, silver	Production
	Quiruvilca	Pan American Silver Corp.	Silver, zinc, lead, copper	Production
	Tabmo Grande	Manhattan Minerals Corp.	Copper, zinc, silver	Production
Philippines	Bulawan	Philex Gold Inc.	Gold	Production
	Mindoro	Crew Development Corporation	Nickel	Feasibility
	Sibutad	Philex Gold Inc.	Gold	Care and maintenance
Portugal	Aljustrel	EuroZinc Mining Corporation	Zinc, lead, copper, silver	Feasibility
Russia	Irokinda	High River Gold Mines Ltd.	Gold	Production
	Julietta	Bema Gold Corporation	Gold, silver	Construction
	Kubaka	Kinross Gold Corporation	Gold, silver	Production
	Zun-Holba	High River Gold Mines Ltd.	Gold	Production
Sierra Leone	Koidu	DiamondWorks Ltd.	Diamonds	Suspended
South Africa	Klipspringer (Fissure)	SouthernEra Resources Limited	Diamonds	Construction
	Maranda	Crew Development Corporation	Zinc, copper	Production
	Marsfontein (M1 Pipe)	SouthernEra Resources Limited	Diamonds	Production
	Messina	SouthernEra Resources Limited	Platinum group metals, copper, nickel	Financing

TABLE 1. (cont'd)

Country	Project	Canadian Participants	Products	Status
	Murchison	Crew Development Corporation	Gold, antimony	Production
	Nigramoep	Crew Development Corporation	Copper	Production
	O'Okiep (smelter)	Crew Development Corporation	Copper	Production
	Palmietgat	Trivalence Mining Corporation	Diamonds	Production
	Ryedale (Metmin)	Crew Development Corporation	Manganese	Production
	So Ver	Diamcor Mining Inc.	Diamonds	Production
	South Deep	Placer Dome Inc.	Gold	Production
	Vergenoeg	Crew Development Corporation	Fluorite	Production
	Wakefield	Crew Development Corporation	Coal	Production
South Korea	Onsan (refinery)	Inco Limited	Nickel	Production
Spain	Carlés	Rio Narcea Gold Mines Ltd.	Gold	Production
	El Valle	Rio Narcea Gold Mines Ltd.	Gold	Production
	Los Frailes (Apirsa)	Boliden Limited	Zinc, copper, lead, silver	Production
Sweden	Aitik	Boliden Limited	Copper, gold, silver	Production
	Åkerberg	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Garpenberg	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Kristineberg	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Laisvall	Boliden Limited	Lead, zinc, silver	Production
	Maurlinden	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Petiknäs	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Renström	Boliden Limited	Zinc, copper, lead, gold, silver	Production
	Rönnskär (smelter and refinery)	Boliden Limited	Copper, lead, zinc, gold, silver, nickel, platinum group metals, sulphuric acid	Production
Taiwan	Kaohsiung (refinery)	Inco Limited	Nickel	Production
Tajikistan	Aprelevka	Gulf International Minerals Ltd.	Gold	Construction
Tanzania	Bulyanhulu	Barrick Gold Corporation	Gold	Production
Thailand	Somboon	Asia Pacific Resources Ltd.	Potash	Feasibility
Tunisia	Bougrine	Breakwater Resources Ltd.	Zinc, lead	Production
Turkey	Çayeli	Inmet Mining Corporation	Copper, zinc, gold, silver	Production
United Kingdom	Acton (refinery)	Inco Limited	Platinum group metals	Production
	Burntisland (refinery)	Alcan Inc.	Aluminum	Production
	Clydach (refinery)	Inco Limited	Nickel, cobalt	Production
	Kinlochleven (smelter)	Alcan Inc.	Aluminum	Production
	Lochaber (smelter)	Alcan Inc.	Aluminum	Production
	Lynemouth (smelter)	Alcan Inc.	Aluminum	Production
United States	American Tripoli	Fording Inc.	Tripoli	Production
	Bald Mountain	Placer Dome Inc.	Gold	Production
	Betze-Post (Goldstrike)	Barrick Gold Corporation	Gold	Production
	Castle Mountain	Viceroy Resource Corporation	Gold	Production
	Cortez (Pipeline)	Placer Dome Inc.	Gold, silver	Production
	Crow Butte	Cameco Corporation	Uranium	Production
	DeLamar	Kinross Gold Corporation	Gold, silver	Suspended
	Denton-Rawhide	Kinross Gold Corporation, Dayton Mining Corporation	Gold, silver	Production
	Eveleth	Stelco Inc.	Iron	Production
	Fort Knox	Kinross Gold Corporation	Gold	Production
	Golden Sunlight	Placer Dome Inc.	Gold	Production
	Hayden Hill	Kinross Gold Corporation	Gold, silver	Production
	Hibbing	Stelco Inc.	Iron	Production
	Highland	Cameco Corporation	Uranium	Production
	Hycroft	Vista Gold Corp.	Gold, silver	Suspended
	Jamboree	Stelco Inc.	Coal	Production
	Ken Snyder	Franco-Nevada Mining Corporation Limited	Gold	Production
	Lisbon Valley	Summo Minerals Corporation	Copper	Feasibility
	Meikle (Goldstrike)	Barrick Gold Corporation	Gold	Production
	New Madrid (smelter)	Noranda Inc.	Aluminum	Production
	Pend Oreille	Cominco Ltd.	Zinc, lead	Feasibility
	Pogo	Teck Corporation	Gold	Feasibility
	Rasmussen Ridge (Conda)	Agrium Inc.	Phosphate	Production
	Red Dog	Cominco Ltd.	Zinc, lead, silver	Production
	Sebree (smelter)	Alcan Inc.	Aluminum	Production
	Tilden	Algoma Steel Inc., Stelco Inc.	Iron	Production
	Wharf	Goldcorp Inc.	Gold	Production
	Willsboro (Nyco)	Fording Inc.	Wollastonite	Production
Uruguay	San Gregorio	Crystallex International Corporation	Gold	Production

TABLE 1. (cont'd)

Country	Project	Canadian Participants	Products	Status
Venezuela	Albino-1	Crystallex International Corporation	Gold	Feasibility
	Loma de Niquel	iTech Capital Corp.	Nickel	Construction
	Tomi	Crystallex International Corporation	Gold	Production
Zambia	Bwana Mkubwa	First Quantum Minerals Ltd.	Copper, sulphuric acid	Production
	Chibuluma South	Crew Development Corporation	Copper	Production
	Chibuluma West	Crew Development Corporation	Copper, cobalt	Production
	Mufulira	First Quantum Minerals Ltd.	Copper	Production
	Mulfira (refinery)	First Quantum Minerals Ltd.	Copper	Production
	Mulfira (smelter)	First Quantum Minerals Ltd.	Copper	Production
	Nkana	First Quantum Minerals Ltd.	Copper, cobalt	Production
	Nkana (refinery)	First Quantum Minerals Ltd.	Copper, cobalt	Production
Zimbabwe	Blanket	Kinross Gold Corporation	Gold	Production
	Blue Rock	Conquest Resources Limited	Gold	Production
	Connemara	First Quantum Minerals Ltd.	Gold	Suspended
	Glencairn	Conquest Resources Limited	Gold	Production
	Shamrock	Conquest Resources Limited	Gold	Production

Source: Natural Resources Canada, based on company reports available as at July 2001.
Note: Canadian companies have interests in hundreds of other less advanced projects around the globe at the exploration stage of the mineral development process.

Aluminum

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World production of primary and recycled aluminum reached a record in 2000 of an estimated 32.5 Mt, up 2.5% from 31.8 Mt in 1999. Of this, 24.4 Mt was primary material, compared to 23.7 Mt in 1999. This amount of primary aluminum production exceeds the amount of total production of all other nonferrous metals combined, although it is less than 5% of global steel production.

Among the International Aluminium Institute (IAI)[1] members, the primary aluminum production rate increased 1.2% during the year to 58 400 t/d in December 2000 from an average of 57 700 t/d in December 1999. The average production rate for all of 2000 was 57 900 t/d, compared with an average rate of 56 600 t/d in 1999, an increase of 2.3%. This average daily production rate has been growing at about 2% per year since 1980, and about 4% per year since 1960 (Figure 3).

Although IAI inventories of unwrought aluminum remained relatively constant at around 1.8 Mt, primary aluminum inventories at the London Metal Exchange (LME) decreased throughout the year. LME primary aluminum inventories started the year at approximately 775 000 t, peaked at 860 000 t in February, and then steadily decreased to 322 000 t at the end of the year. Various authors have suggested that this decrease represents a fundamental long-term change resulting from the electronic trading of metals. The aggregate total of IAI and LME stocks decreased from 4.034 Mt at the end of 1999 to a low of 3.478 Mt in November 2000. Stocks then increased to 3.5 Mt at year-end. (The IAI has an Internet site at http://www.world-aluminium.org.)

Aluminum prices were volatile in 2000. After increasing throughout 1999 from a five-year low of US52¢/lb reached in March 1999, prices reached a two-and-one-half-year high in January 2000 of US79¢/lb. Since then, aluminum prices have generally traded in this range, ending 2000 at about US71¢/lb.

Primary aluminum cash settlement prices on the LME started 2000 at US$1615/t (US73¢/lb), increased to the year's high of US$1745/t (US79¢/lb) in January, and then fell to the year's low of just below US$1400/t (US63¢/lb) in April. Prices fluctuated between that price and US$1640/t (US75¢/lb) during the rest of the year to end it at US$1560/t (US68¢/lb). The average price for the year was US$1550/t (US70¢/lb), compared to an average of US$1362/t (US62¢/lb) in 1999 (Figure 10).

The IAI also reported that members' alumina production capacity increased to 51.479 Mt/y in December 2000 from a revised 48.490 Mt/y in December 1999, while alumina production also rose to 48.1 Mt in 2000 from 45.8 Mt in 1999.

The alumina market weakened during the year as expansions and increased utilization of existing and new capacity countered the effect of lost production at Kaiser's Gramercy refinery. *Metal Bulletin* reports that spot prices for metallurgical-grade alumina have declined to US$165-$180/t from over US$400/t in early 2000.

Aluminum, in both its pure and alloyed form, is used to make a wide variety of products for the consumer and capital goods markets. Aluminum's largest market sectors are transportation (29%), packaging (18%), building and construction (19%), electrical

CANADIAN PRIMARY ALUMINUM, 1997-2000

	1997	1998	1999	2000p
	(000 tonnes)			
Production	2 327	2 374	2 390	2 400
Apparent use	628	734	840	798

p Preliminary.

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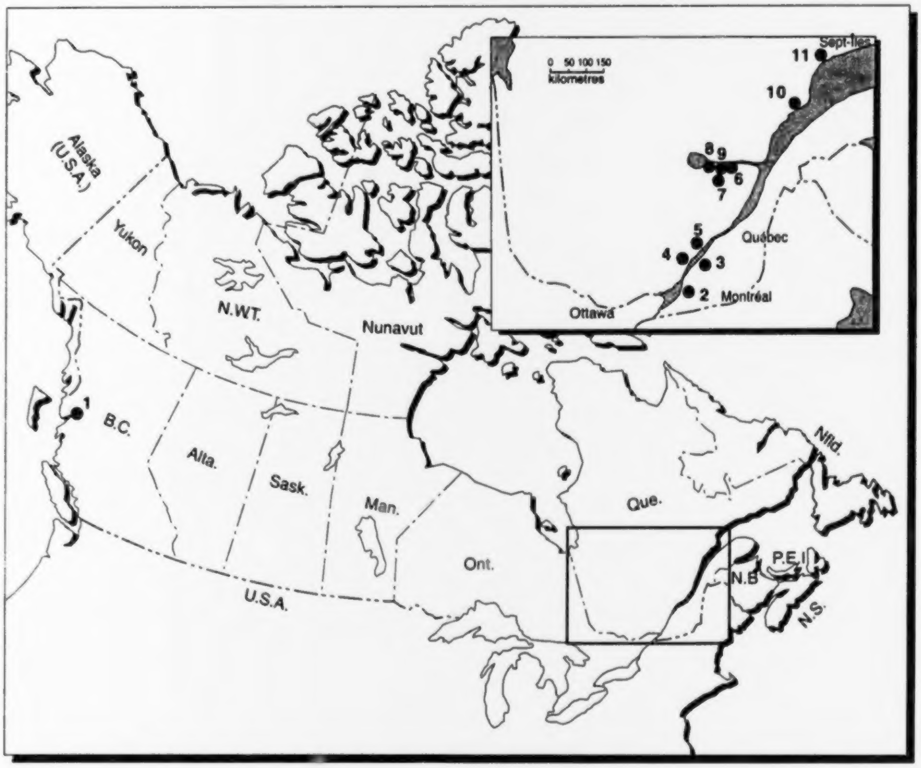
[1] The International Primary Aluminium Institute (IPAI) changed its name to the International Aluminium Institute (IAI) in 2000. Note: The IAI reporting system for inventories was revised in 1999.

Figure 1
Aluminum Smelters, 2000


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
1
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
0 50 100 150
kilometres
Sept-Îles
11
10
8
9
6
7
5
4
3
2
Québec
Montréal
Ottawa

SMELTER	COMPANY	CAPACITY (t/y)
1. Kitimat	Alcan	272 000
2. Beauharnois	Alcan	49 000
3. Bécancour	A.B.I.	390 000
4. Shawinigan	Alcan	88 000
5. Lauralco	Alcoa Lauralco	240 000
6. Grande-Baie	Alcan	186 000
7. Laterrière	Alcan	210 000
Alma	Alcan	400 000[a]
8. Isle-Maligne	Alcan	25 000[b]
9. Arvida	Alcan	238 000
10. Baie-Comeau	Canadian Reynolds Metals (Alcoa)	418 000
11. Alouette	Alouette	244 000

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[a] Will reach full capacity in mid-2001. [b] The last potline closed permanently in March 2000.

(9%), consumer goods (7%), and machinery and equipment (6%).

The World Bureau of Metal Statistics (WBMS) reported that, in 1999, Asia was the region in the world with the largest aluminum use, accounting for 34% of total world primary aluminum use. North America accounts for 30% and Europe for 30%. (WBMS has an Internet site at http://www.wbms.dircon.co.uk.)

Metals, including aluminum, are recycled and are not consumed during use in consumer and most industrial applications. Discussions on metals taking place in a number of fora indicate that the terms should be changed to more appropriately reflect actual practice. As a result, the words "consume" and "consumed" commonly used in reports on metal use have been replaced where applicable with more appropriate terms (e.g., "apparent consumption" has been changed to "apparent use").

In the same vein, recycled aluminum is often referred to as secondary aluminum. While this latter terminology reflects a use beyond the primary use and production, the term is confusing to many people as aluminum is recycled many times and the product obtained and used in new products meets the specifications of new material for that application rather than the specifications of a second-class or lower-quality product. The use of the word "secondary" has therefore also been replaced by "recycled."

CANADIAN DEVELOPMENTS

The production of primary aluminum decreased by 0.7% to 2.373 Mt in 2000 from 2.390 Mt in 1999. The reduction was due to the closure of Alcan's Isle Maligne smelter in March 2000. Canada ranks fourth after the United States, Russia and China in terms of world production. The value of Canadian production, estimated at $5.5 billion, compared to $4.8 billion in 1999, reflects the increased metal price in 2000. Monthly Canadian production statistics can be obtained on Natural Resources Canada's Internet site at http://www.nrcan.gc.ca/mms/efab/data.

Reported Canadian use of aluminum metal at the first processing stage, including rcycled aluminum, was 999 242 t in 1999, up 12% from a revised figure of 902 514 t in 1998. Part of this increase was due to an increase in the number of companies reporting.[2]

Canada is the second largest aluminum-exporting country in the world after Russia. Canadian exports of primary smelter products in 2000 decreased in quantity to 1.837 Mt but increased in value to $4.529 billion, compared to 1.862 Mt valued at $4.05 billion (revised) in 1999. Of this amount, exports to the United States totaled 1.44 Mt valued at $3.62 billion, compared to 1.51 Mt valued at $3.33 billion (revised) in 1999 (Tables 3a and 3b).

British Columbia's *Power for Jobs Strategy* makes surplus electrical power available to industry, under flexible terms and conditions, to create jobs and investment. One of the industries the province has targeted is aluminum. The province continued discussions with several aluminum producers to undertake planning and feasibility studies that may lead to the development of smelters and value-added facilities in British Columbia. (Additional information is available on the Internet at http://www.gov.bc.ca or http://www.gov.bc.ca/ei.)

Alcan Aluminium Limited continues to maintain its position as a low-cost supplier of bauxite, alumina and aluminum. On August 11, 1999, Alcan, Pechiney Corporation of France and Alusuisse Lonza Group Limited (algroup) of Switzerland proposed a merger. The Alcan-Alusuisse portion of the merger was completed in October 2000; the Alcan-Pechiney portion of the merger was withdrawn due to European Commission concerns. In the resulting merger, Alusuisse was valued at US$5.67 billion. The new Alcan, the largest specialty packaging company in the world, had combined revenues of US$13 billion and 53 000 employees in 37 countries. Shortly after the merger was completed, Alcan Aluminium Limited officially changed its name to Alcan Inc. to reflect its more diversified product mix and global character. (Alcan has an Internet site at http://www.alcan.com.)

Alcan owned 46% of total Canadian primary aluminum smelter capacity, and this portion is set to increase to 54% in 2001 with the completion and ramping up of the Alma smelter. The $2.2 billion Alma smelter started producing metal in October 2000 and is expected to reach its full production capacity of 400 000 t/y in mid-2001. The smelter employs 650 people (including 425 employees who transferred from Isle-Maligne). Alma uses Pechiney AP30 technology and is one of the most efficient facilities in the world. Costs are expected to be in the lowest quartile when compared to other smelters.

In late 2000, Alcan announced that it planned to shut down one of six potlines at the 272 000-t/y Kitimat smelter due to lower water levels in the Nechako Reservoir for the Kemano hydro-electric generating station. In early 2001, however, due to energy conservation measures and other arrangements with BC Hydro, the shut-down was avoided although production was expected to be reduced by approximately 40 000 t over 16 months.

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[2] These numbers may include runaround scrap. Work is under way to obtain clarification.

Alcoa Inc. became the second largest primary aluminum producer in Canada with the completion of its merger with Reynolds Metals Company Limited. After the merger Alcoa owned about 44% of total Canadian primary aluminum smelting capacity. Alcoa owns the 240 000-t/y Lauralco smelter located in Deschambault, Quebec, the 418 000-t/y Baie-Comeau smelter in Baie-Comeau, Quebec, and a 74.95% interest in the 390 000-t/y Aluminerie de Bécancour Inc. (A.B.I.) smelter located in Bécancour, Quebec. Alcoa's other corporate partner in A.B.I. is Pechiney Corporation of France (25.05%).

On a corporate level, Alcoa looked at the possibility of expansions at its existing smelters, including all three of its smelters in Canada. When these smelters were first constructed, planning was done to allow for easy expansion. Also during the year, Alcoa formed a new Northeastern Division based in Montréal to manage the Lauralco, Baie-Comeau and A.B.I. smelters in Canada and its two smelters in Massena, New York. The rationalization and consolidation of services resulted in a reduction of 260 jobs at the Baie Comeau smelter; 85% of these reductions were met through attrition and early retirement.

The 390 000-t/y A.B.I. smelter was the second largest Canadian smelter in 2000. It is owned by Alcoa (74.95%) and Pechiney SA (25.05%). During the year, the company and the Syndicat des Employés de l'Aluminerie de Bécancour (SEAB) signed a four-year labour contract. A.B.I. had previously indicated that it would like to add a fourth potline to increase capacity; however, plans require an additional power supply contract.

Partners in the 244 000-t/y Alouette smelter at Sept-Îles, Quebec, studied a doubling of capacity through a potential $1 billion expansion, which would require a new power contract. The partners include: Aluminium Austria Metall Québec (20%), VAW Aluminium Canada (20%), Corus Aluminium Québec Inc. (20%), Société générale de financement du Québec (20%), Kobe Aluminium Canada Inc. (13.33%), and Marubeni Québec Inc. (6.66%).

In British Columbia, KPI Technology and Development LLC, an independent consulting firm based in Spokane, Washington, worked on a pre-feasibility study for a new 360 000-t/y smelter to be located near Port Alberni, Vancouver Island. B.C. Hydro and the provincial government are currently conducting a power supply study for the 650-MW project. KPI and officials from the town of Port Alberni expected a feasibility study to start in late 2001. (Additional information is available on the Internet at http://www.bchydro.bc.ca/pagp, http://www.alberni-region.com and www.ktdal.com.)

In Quebec, Lavalum, L.P. opened a $20 million aluminum recycling smelter with a capacity of 35 000 t/y. Lavalum, a joint venture of Société nationale des ferrailles inc. (SNF) (60%) and SGF Mineral inc. (a subsidiary of Société Générale de financement du Quebec [40%]), will employ 60 people. (Additional information is available on the Internet at http://www.snf.ca and http://www.sgfqc.com.)

In September, the Canadian Aluminium Industry Technological Roadmap was published by the National Research Council of Canada, Canada Economic Development, Industry Canada and Réseau Trans-Al Inc. with the cooperation of the Aluminium Association of Canada, major industry stakeholders, suppliers and universities. Following a year of consultation and analysis, the Roadmap provides planning information for future industry needs. An electronic copy can be obtained from the Internet site of the Centre québécois de recherche et de développement de l'aluminium (CQRDA) at http://www.cqrda.qc.ca.

Following up on the recommendations contained in the Roadmap, the Government of Canada announced in October a $52 million federal contribution for a new National Research Council of Canada research centre in the Saguenay–Lac-Saint-Jean region. The new centre will be established on the University of Quebec's Chicoutimi campus. The centre will assist industry in developing value-added products to fill gaps in Canadian production capabilities.

The Aluminium Association of Canada is a non-profit organization supported by Canada's aluminum producers: Alcan Inc., Alcoa Inc. and Aluminerie Alouette Inc. The Association serves as a link between the Canadian aluminum industry, aluminum users, the public and governments. The Association's Internet site, located at http://www.aia.aluminium.qc.ca, has information on, and links to, Canada's primary aluminum producers.

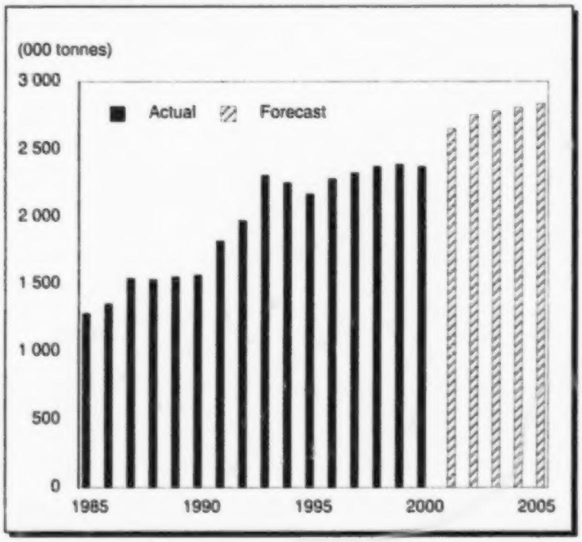
CANADIAN OUTLOOK

Canada is expected to produce about 2.6 Mt of primary aluminum in 2001, up from the 2.4 Mt produced in 2000. The increase will be due to the planned completion of the new Alcan smelter at Alma.

Although Canadian aluminum production capacity increased substantially during the latter half of the 1980s, it remained relatively stable during the 1990s. Canada's production capacity will increase to 2.7 Mt/y in 2001 with the completion of Alcan's Alma smelter. Other smelter expansion projects in Quebec (at Alouette, A.B.I. and Lauralco) are dependent on the negotiation of additional long-term power supply contracts with Hydro-Québec. Decisions and results of work on possible new capacity in British Columbia are still pending.

In 2000, Canada's reported use of aluminum is expected to increase 3% from 1999. Total reported use is estimated at 1.03 Mt of aluminum, which includes 0.74 Mt of primary aluminum. Canada ranks fourth in primary aluminum use after the United States, Russia and China.

Figure 2
Canadian Primary Aluminum Production, 1985-2005



Source: Natural Resources Canada.

World Developments

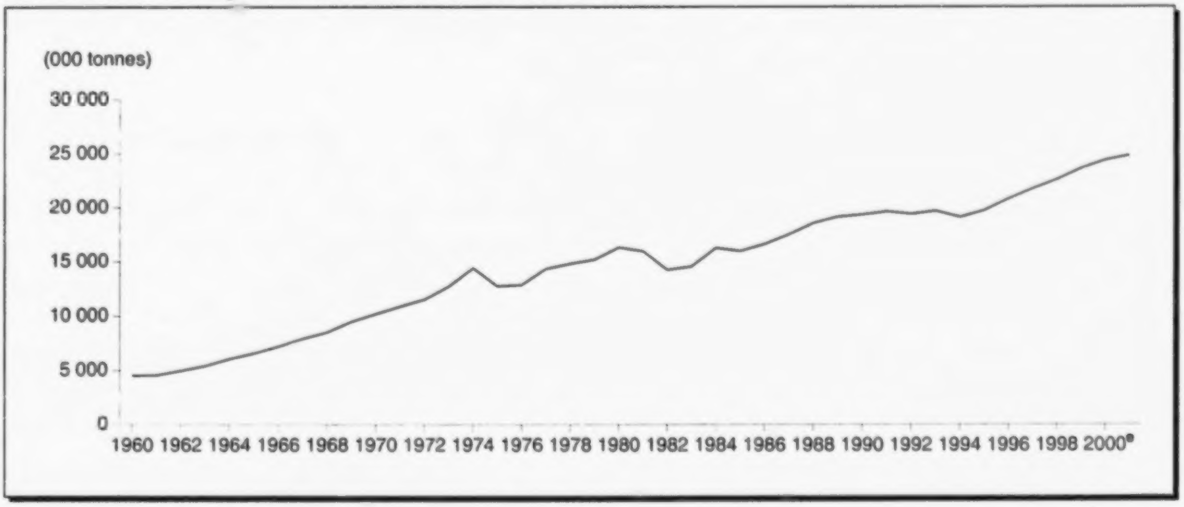
In 2000, producers continued to focus on cost reduction and increased competitiveness through economies of scale through mergers, acquisitions and technological improvements to facilities. Three major mergers and several smaller ones were completed in the ongoing consolidation of aluminum smelting and manufacturing capacity in large global corporations.

Alcoa Inc. and Reynolds Metals Company Limited completed their merger after receiving regulatory approval from regulatory authorities, conditional on sales of assets in a number of locations. Alcoa remains the largest producer of primary aluminum in the world. Alcoa produced 3.5 Mt of primary aluminum and 14 Mt of alumina, representing approximately 17% of IAI reported primary production and 29% of IAI reported alumina production. (Alcoa has an Internet site at http://www.alcoa.com.)

Alcan Aluminium completed its merger with Alusuisse as discussed above. At year-end, Alcan had a smelting capacity of approximately 2.2 Mt/y of primary aluminum and 5.3 Mt/y of alumina refining capacity. This represents approximately 10% of IAI reported primary production and 11% of IAI reported alumina production. (Alcan has an Internet site at http://www.alcan.com.)

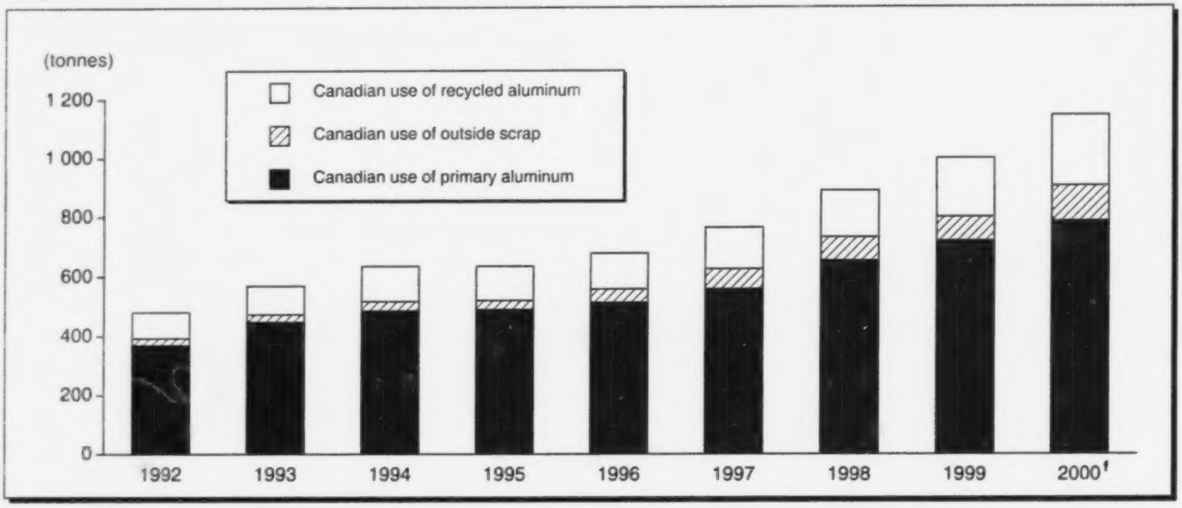
Russky Aluminii, or Russian Aluminium, was formed through an amalgamation of Sibirsky Aluminium's assets with the aluminum interests of Sibneft Oil. At year-end, Russky Aluminii had 2.1 Mt/y of primary

Figure 3
World Total Primary Aluminum Production, 1960-2000



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
e Estimated.

Figure 4
Reported Use of Aluminum in Canada, 1992-2000



Source: Natural Resources Canada.

[f] Forecast.

Note: The use of aluminum may be overstated; survey forms have been revised for 2001.

aluminum production capacity in the Bratsk, Krasnoyarsk and Sayansk smelters and an interest in the Novokuznetsk smelter, the Achinsk and Mykolayivsky (Ukraine) alumina refineries, and other downstream facilities.

As energy prices soared in the western United States in mid-year, higher costs resulted for smelters without long-term contracts. By year-end, approximately 700 000 t of annual capacity was closed. New Bonneville Power Administration (BPA) contracts will reduce the power available to the smelters and new sources of power will be required if aluminum production in the region is to be maintained at capacity.

The decreased U.S. primary aluminum production was made up by increased production throughout the rest of the world; the IAI indicates a world daily average production in December of 58 400 t, up 700 t/d from the 57 700 t/d rate in December 1999.

Two greenfield primary smelters started producing aluminum in 2000, adding 650 000 t/y of capacity in 2001. In addition to the Alcan Alma smelter discussed above, Billiton Plc.'s US$1.3 billion Mozal smelter in Mozambique cast its first metal. This smelter is expected to reach its full capacity of 250 000 t/y early in 2001.

During 2000, there was an increase in electronic marketing activity as metal producers and users focused on new ways to market products and purchase supplies. For example, General Motors Corporation expects to source a large proportion of purchases online by 2001. Initiatives included:

- Aluminium.Com, a business-to-business electronic commerce company established in 1999, continued its efforts to create a global Internet marketplace;
- Covisint, an Internet procurement company was launched by partners including General Motors, Daimler-Chrysler AG, Ford Motor Company, Renault SA, Nissan Motor Co., Oracle and Commerce One (http://www.covisint.com);
- Quadrem, a mining and metals online procurement marketplace, was formed for the global mining, minerals and metals industries (http://www.quadrem.com and http://www.mmprocurement.com);
- the LME opened LME Select, an electronic trading platform;
- a metals Internet trading exchange for nonferrous metals, EMETRA, started operations in February (http://www.emetra.com); and
- Metals-Russia.com was established for metals, raw materials and equipment related to the Russian metals industry (http://www.metals-russia.com).

United States

The Aluminum Association, Inc. reported that the United States, the world's largest producer of primary and recycled aluminum, produced a total of 3.668 Mt of primary aluminum in 2000, down 2.9% from the 3.778 Mt produced in 1999. The World Bureau of Metal Statistics reports that 3.4 Mt of aluminum were recycled in the United States, representing approximately 42% of recycled aluminum worldwide (8.2 Mt) in 2000.

Increased power costs and decreased availability caused disruptions to the aluminum smelters and their employees in the western United States. Smelter contracts with the BPA, renewed in late 2000, reduced the amount of power available to the smelters. Smelters affected by the power shortages and increased power costs have a combined capacity of about 1.9 Mt/y. In early 2001, approximately 900 000 t of that smelting capacity had been closed with no certainty as to when or if it would re-open. Some producers have started to develop additional power supplies for a longer-term solution, such as Goldendale Aluminum's new 248-MW gas-fired power facility that will come online in mid-2002.

The affected smelters have included: Alcoa's Troutdale, Oregon and Ferndale, Washington smelters; Alcoa's Wenatchee, Washington smelter (in early 2001); Michigan Avenue Partner's (formerly Reynold Metals Co.'s) Longview, Washington smelter (in early 2001); Kaiser Aluminum & Chemical Corporation's smelters in Tacoma and Mead, Washington; Vanalco Inc.'s Vancouver, Washington smelter; and Golden Northwest Aluminum Inc.'s Goldendale smelters in Washington and Dalles, Oregon. Glencore Ltd.'s Columbia Falls, Montana smelter and Ormet Corp.'s Hannibal, Ohio smelter also suffered.

Power costs also affected fabricators. By the end of 2000, energy surcharges were being imposed by firms in an attempt to recover the increased energy costs for transformation. In response to the general situation and to the disruption and uncertainty facing communities and the aluminum industry, the BPA created a study team. At year-end, several economic studies were under way on the viability and role of aluminum smelting in the northwestern United States. (Additional information is available on the Internet at http://www.bpa.gov and http://www.uswa329.org.)

In February, Reynolds Metals Company shareholders approved a merger with Alcoa. In May, regulatory authorities in the United States and the European Union approved the merger with several conditions. The resulting merger, valued at US$5.9 billion, reinforced Alcoa's standing as the largest aluminum company in the world. Alcoa was required to divest Reynolds' interests in three alumina refineries and a partial interest in the Longview, Washington smelter. Pursuant to those conditions, Alcoa:

- agreed to sell the Worsley refinery to Billiton Plc. in August (refer to the section on Australia);
- agreed to sell the former Reynold's Longview, Washington, smelter to Michigan Avenue Partners in December (after regulatory approvals, the sale of the 204 000-t/y smelter was completed in February 2001 [http://www.mccookmetals.com]);
- completed the sale of the 1.6-Mt/y Sherwin alumina refinery located near Corpus Christi, Texas, to BPU Reynolds, Inc., a private investment company, in December (the Reynolds Metals Company plant has been producing 200 000 t/y of chemical alumina and BPU intended to expand that portion of production); and
- held ongoing negotiations at year-end that were expected to be completed in early 2001 to divest Reynolds' interests in an alumina refinery in Stade, Germany.

Alcoa made a number of other changes to its operations, including:

- In January, Alcoa announced the restart of approximately 200 000 t/y of idled capacity. This represented about one half of the remaining idled capacity resulting from closures in the early 1990s when world production capacity and production increased more than use.
- Alcoa acquired Cordant Technologies Inc., a technology-based company serving global aerospace and industrial markets, and Howmet International Inc., the world's largest manufacturer of precision castings. The acquisition was valued at US$3.3 billion.
- In January 2001, Alcoa World Alumina and Chemicals (AWAC), a joint venture of Alcoa and WMC Limited, suspended operations at the St. Croix alumina refinery in the U.S. Virgin Islands. The refinery had a capacity of 600 000 t/y but was producing at a lower rate of 450 000 t/y. The alumina produced at St. Croix was sold to Alcoa's smelters in the United States and, with the cutbacks in the western United States, this alumina was no longer needed. Future production will be evaluated by AWAC in light of supply requirements.
- Early in 2001, Alcoa announced a reduction in alumina production at its Point Comfort, Texas, refinery to 1.6-1.9 Mt/y from its capacity of 2.3 Mt/y and the temporary closure of its aluminum fluoride production plant at Fort Meade, Florida.

Alcan Aluminum Corporation announced in May the restart of 60 000 t/y of idle capacity at Sebree, Kentucky, by the end of October. The capacity was taken off-line during the early 1990s due to oversupply in the aluminum market. Alcan also announced that it would increase billet capacity by 65 000 t/y. When completed in 2002, most of the output of the 185 000-t/y smelter will be used for billets.

Alcan continued to upgrade its U.S. rolling facilities. For example, it will complete an expansion of its Terre Haute, Indiana, light-gauge rolling facility by 22 700 t/y by mid-2001. This facility is among the world's largest and most technologically advanced producers of light-gauge aluminum fin and foil products.

Kaiser faced increased costs for power at its two U.S. smelters. The company's 73 000-t/y Tacoma, Washington, smelter was closed in June, and the last 90 000 t/y still operating at the 200 000-t/y Mead, Washington, smelter was closed at year-end.

Kaiser obtained environmental approvals and started reconstruction of its Gramercy, Louisiana, alumina refinery, which was destroyed in 1999 by an explosion. The US$275 million plant began partial operation in December and construction was scheduled to be completed in mid-2001. The 1.25-Mt/y plant was expected to be in full operation in mid-2001.

Kaiser and the United Steelworkers reached a settlement ending a two-year dispute at five Kaiser U.S. operations. A five-year agreement was signed in September. (Additional information is available on the Internet at http://www.kaiseral.com and http://www.uswa.org.)

In April, Century Aluminum Company purchased an additional 23% of the Mt. Holly smelter in South Carolina from Xstrata AG for US$95 million. Century now owns 49.67% of the 215 000-t/y plant, which is the newest smelter in the United States. Alcoa acquired the remaining portion of the smelter with its acquisition of Alumax Inc. and manages the facility. Century also reached an agreement with National Southwire Aluminum Co. to purchase the 236 000-t/y Hawesville, Kentucky, smelter for US$460 million and to assume US$8 million in industrial revenue bonds. As part of the smelter purchase, the company reached an agreement with United Steelworkers Union Local 9423 on a five-year contract. Completion of the sale was expected in early 2001. Century also owns a 168 000-t/y smelter in Ravenswood, West Virginia and, with three smelters, has become the second largest aluminum producer in the United States. (Century has an Internet site at http://www.centuryaluminum.com.)

In September, due to high power costs, Golden Northwest Aluminum Inc. announced a 40% cutback, of 100 000 t/y, in production at its smelters with an aggregate capacity of 250 000 t/y in Washington and Oregon. Later in the year, the company announced the complete closure of the Dalles smelter in Oregon and a reduction of Goldendale, Washington's production to 25 000 t/y. Norsk Hydro and Golden Northwest had previously stated that they would proceed with a US$55 million smelter upgrade and an expansion program, including an increase in casting capacity at Goldendale; they also extended their tolling agreement to 2012. Goldendale signed an agreement with an independent power producer and the BPA to construct a new 248-MW, gas-fired power facility to provide power to its smelter. This power plant was expected to be completed in mid-2002. (Additional information is available on the Internet at http://www.nwaluminum.com.)

Columbia Falls Aluminum Company operates a 163 000-t/y smelter in Columbia Falls, Montana. Power cost and availability forced the closure of 80 000 t/y of capacity in 2000 and the company announced a complete plant closure in January 2001. The company has agreed to work with the BPA to construct additional electricity generation capacity. (Columbia Falls has an Internet site at http://www.cfaluminum.com.)

In September 2000, Noranda Aluminum Inc. (Norandal) started producing heavy-gauge foil at a new US$238 million, 90 000-t/y mill in Huntingdon, Tennessee. The plant was expected to reach full capacity in early 2001. (Noranda has an Internet site at http://www.noranda.com.)

Hydro Aluminium started production in November 2000 at an aluminum scrap remelt facility in Henderson, Kentucky. The US$33 million plant will produce 90 000 t/y of primary-quality billet. The plant can be easily expanded to 120 000 t/y. (Hydro Aluminum has an Internet site at http://www.hydro.com.)

The Aluminum Association, based in Washington, D.C., represents U.S. and foreign-based primary producers of aluminum, recyclers, and producers of semi-fabricated products. Member companies operate almost 200 plants in 37 states. (The Aluminum Association has an Internet site at http://www.aluminum.org.)

Jamaica

The Kaiser Jamaica Bauxite Company (KJBC) operation, owned by Kaiser Aluminum Corporation and the Jamaican government, reduced its bauxite production in 1999 as a result of the closure of Kaiser's Gramercy U.S. alumina plant in mid-1999. The company increased the production rate of Jamaican bauxite in mid-2000 and expected to reach its full capacity of 2.4 Mt/y in 2001.

Alcan announced in early 2001 that it may sell its bauxite and alumina operations in Jamaica. Alcan Jamaica, owned by Alcan (93%) and Jamaican Bauxite Mining Limited (7%), has two alumina refineries at Kirkvine and Ewarton with a combined capacity of 1.2 Mt/y with captive bauxite mines.

South America

In **Argentina**, ALUAR-Aluminio Argentino SA continued studying a US$2 billion expansion program. Work focused on two possible projects: a new US$1.5 billion, 250 000-t/y smelter in the province of Santa Cruz and a US$400 million expansion of the Puerto Madryn smelter to expand capacity by 140 000 t to 400 000 t/y. Associated rolling facilities, port facilities and electrical infrastructure would be included in this work. Decisions were expected in early 2001 and, if favourable, construction could be completed in 2003.

Alcan conducted studies for an additional US$200 million expansion of the Pindamonhangaba rolling mill in the state of Sao Paulo in southern **Brazil**. Alcan expanded the plant at a cost of US$370 million to 280 000 t/y from 120 000 t/y in 1999 and utilization of that capacity was increasing faster than originally expected. Alcan also planned to increase its recycling centre at the Pindamonhangaba mill to 120 000 t/y from its current 80 000 t/y.

Alcoa Aluminio S.A. manages the Alumar Consortium smelting and refining plants near Sao Luis, Maranhao, in northeastern Brazil. Billiton Plc, one of the Alumar partners, conducted a study for a US$800 million, coal-fired power plant as an alternative power supply. Alcoa Aluminio also operates a 270 000-t/y refinery at Pocos de Caldas and is participating in a consortium building the new Machadinho hydro-electric power plant in southern Brazil. Completion of Machadinho is expected in 2002.

Alumina do Norte do Brasil S.A. (Alunorte) announced an expansion of its 1.5-Mt/y alumina refinery in Barcarena, Pará to 2.3 Mt/y at a cost of US$332 million. Brazil's Development Bank (BNDES) will provide US$230 million in financing. Construction was expected to be completed in 2002 with the facility reaching full capacity in mid-2003.

Companhia Vale Rio do Doce (CVRD) received a US$56 million loan from BNDES for the US$100 million expansion of the Albras aluminum smelter to 405 000 t/y from 350 000 t/y. Work is expected to be completed in mid-2001. CVRD also began studying a further expansion of Albras to 580 000 t/y.

The Mineracao Rio do Norte Board approved an expansion of bauxite production capacity at the Trombetas bauxite mine to support expansions at the Alunorte and Alumar alumina refineries. The expansion will result in a 60% increase in bauxite production to 16.3 Mt/y from the current capacity of 11 Mt/y. Trombetas is expected to reach this mining rate in January 2003.

Cia Brasileira de Aluminio (CBA) planned a US$350 million expansion program of its operations in the state of Sao Paulo. The program will see a capacity expansion of the Sorocoba smelter to 340 000 t/y from 230 000 t/y by 2003, with associated expansions at its alumina plants and bauxite mines. Construction was started on the US$10 million, 80-MW Piraju hydro-electric plant on the Paranapanema River as part of a program to increase the company's power generation capacity.

Noranda continued environmental permitting work for its Alumysa hydro-electric and aluminum smelter project near Puerto Aisen in southern **Chile**. An Environmental Impact Study was expected to be completed and submitted to the government in early 2001. The company is looking for partners for the US$1.6 billion, 440 000-t/y smelter, a 777-MW hydro plant, and a new port near Puerto Aisen. The total project would cost an estimated US$2.6 billion and be operational after 2005.

In March 2000, Pechiney announced an agreement with the **Suriname** government to study a new bauxite mine and alumina plant. The Bakhuis bauxite deposit in western Suriname would feed a potential US$700 million, 1-Mt/y alumina plant. Pechiney (49%) and the Suriname government (51%) would be partners in the project. Construction of the plant would start in 2002 after studies and financing are completed.

The Government of **Venezuela** continued efforts to privatize its aluminum interests. The Corporación Aluminos de Venezuela S.A. holds four companies (CVG Alcasa, CVG Bauxilum, CVG Carbonorca and CVG Venalum) that will be split into separate business units. Debt reduction and discussions with a number of potential industry partners for investment in the industry were followed by the negotiation of a five-year investment and management agreement in December with Pechiney on CVG Bauxilum. In exchange for a guaranteed portion of CVG Bauxilum's alumina production, Pechiney will provide management expertise to increase productivity, update the technology, and improve environmental aspects of the operations. The capacity of the alumina plant will increase in a first phase to 2.15 Mt/y at a cost of US$260 million. In addition, a feasibility study for a second expansion to 3 Mt/y will be carried out. A formal agreement was expected to be signed in early 2001. The government also started discussions with a number of companies to restart two potlines and complete construction of a fifth line at Alcasa. (Additional information is available on the Internet at http://www.aluminio.com.ve.)

Europe

The Federation of Aluminium Consumers in Europe (FACE) continued its efforts to promote the use of aluminum, assess the impact of new technologies, and reduce the costs of primary metal through tariff reductions to stimulate demand. FACE was formed in 1999 and now has 44 members from European aluminum-using companies from 12 member states. As the European Union (EU) uses more than double the amount of primary aluminum it produces, FACE estimates that the EU's 6% duty on unwrought aluminum imports costs European consumers US$475 million per year. In early 2001, FACE renewed efforts to achieve consensus among EU members to reduce the duty imposed on unwrought aluminum rather than through a reduced tariff quota. (FACE has an Internet site at http://www.facealuminium.com.)

In February 2000, Britain formally submitted a request to the European Commission to suspend the 6% duty on unwrought aluminum through an autonomous suspension of duty or a tariff quota on part of these imports. The Commission reviewed the request but consensus was not achieved and the duty remains on imports of unwrought aluminum. The Gulf Arab States also have been lobbying against this duty and hope to include it in a free trade agreement.

Kumera Corporation, a privately held engineering company based in **Finland**, conducted studies for a US$800 million, 230 000-t/y smelter at Pori in western Finland. Additional power supplies would be required – likely a new nuclear plant. (Kumera has an Internet site at http://www.kumera.com.)

Alcoa worked to sell Reynolds' interest in an alumina refinery in Stade, **Germany**. This sale was imposed by the European Commission on the Reynolds merger. Alcoa obtained an extension to the original deadline and expected to divest its interest in early 2001.

Hydro Aluminium a.s. announced that it would expand the capacity of the Sunndal smelter in **Norway** by 168 000 t to 321 000 t/y. The US$600 million project involves construction of a new prebake 234 000-t/y potline and closing an existing 66 000-t/y potroom. Construction was expected to be completed in 2004. After the expansion and environmental upgrades, the Sunndal smelter will be Europe's largest smelter with a capacity of approximately 350 000 t/y of extrusion ingot and primary foundry alloys. The environmental improvements will double aluminum production but reduce the total emissions of greenhouse gases from the existing plant, making the plant one of the most environmentally friendly in the world. Additional expenditures will be required at Norsk Hydro's other smelters in Norway to meet EU directives.

After completing feasibility studies, Elkem a/s announced that it would modernize and expand the Mosjoen smelter in Norway from 200 000 t/y to 280 000 t/y and expand the capacity of the cast house to 330 000 t/y. This US$200 million program was expected to be completed in 2003.

Alcoa conducted engineering studies on updating the San Ciprian alumina refinery in **Spain**. The modernization of the plant was expected to increase its capacity from 1.1 Mt/y to 1.3 Mt/y by early in 2001.

Glencore International AG purchased Kubikenborg Aluminium i Sundsvall AB. Kubikenborg owns a 100 000-t/y smelter in Sundsvall, **Sweden**. Kubikenborg originally purchased the smelter from Graenges AB in 1998.

Early in the year, Alusuisse Lonza Group Limited (algroup) decided to continue and expand the operation of the Steg smelter in **Switzerland** from 35 000 t/y to 43 000 t/y after signing a five-year agreement on power prices. Algroup also decided to expand the capacity of the Soral smelter in Husnes, **Norway**, operated in a joint venture with Norsk Hydro A/S, from 115 000 t/y to 130 000 t/y. Algroup subsequently merged with Alcan.

In May, Alcan announced the immediate restart of 50 000 t/y of capacity at the Lynemouth smelter at Ashington, Northumberland, in the **United Kingdom**. The capacity was taken off-line during the 1990s due to oversupply in the aluminum market. In mid-year, Alcan closed the 11 000-t/y Kinlochleven smelter in Argyll, Scotland, which started production in 1909.

The **Montenegro** government announced that it would privatize its 100 000-t/y smelter and associated casting facilities, rolling mill and manufacturing plants. In June 2000, the European Commission granted tariff quotas for aluminum products imported from this complex in Montenegro as part of its efforts to help Balkan countries. (Additional information is available on the Internet at http://europa.eu.int.)

Iceland

Iceland's Minister for Industry and Commerce, Hydro Aluminium a.s., Haefi hf, Landsvirkjun and Reydarál hf signed an agreement to continue studying the feasibility of a new smelter at Noral in Reydarfjördur. Parties hoped to reach a final decision in early 2002. Construction of the first phase of the smelter could begin in 2003 with start-up in 2006. Construction of the Kárahnukar power project, to provide the required additional power supplies for the smelter, was expected to start in 2002 with completion in 2006. The US$1 billion Reydarál smelter would have an initial production capacity of 240 000 t/y and would increase to 480 000 t/y when additional power was available. (Additional information is available on the Internet at http://www.lv.is and http://www.hydro.com.)

Early in the year, Alusuisse Lonza Group Limited (now part of Alcan Inc.) decided to expand capacity at its ISAL smelter from 162 000 t/y to 176 000 t/y. (ISAL has a site on the Internet at http://www.isal.is.)

Early in 2000, Nordic Aluminum Corp. (Nordurál), owned by Columbia Ventures Corporation, completed financing in mid-2000 for a 30 000-t/y expansion to bring the smelter's capacity to 90 000 t/y. Construction was expected to be completed in 2001. (Nordurál has a site on the Internet at http://www.nordural.is.) Columbia Ventures also presented a proposal to the Icelandic government for a new smelter in Reydarfjördur in eastern Iceland. However, only one proposal could go ahead in that location and it appears more likely that the previously noted Norsk Hydro-Haefi proposal will proceed.

Romania

The Government of **Romania** continued to plan for the privatization of a number of state-owned companies, including its 54.7% interest in the ALRO Slatina smelter. Slatina has a nameplate capacity of 265 000 t/y but operated at approximately 175 000 t/y in 2000. The company continued to modernize the smelter to increase efficiency and reduce emissions.

Russky Aluminii re-opened the 250 000-t/y Oradea alumina refinery in late 2000 with plans to reach its full operating rate in 2001. It was expected that capacity would be eventually increased.

Russia

The Russian government raised export tariffs on scrap metals, including aluminum, to 50% from the 30% rate applied in early 2000 to reduce exports of scrap. Late in 2000, the Russian Parliament passed a bill suspending nonferrous scrap exports for four years but, at the end of the year, it was unknown when it would become law. The government also continued discussions on changes to export duties and the phase-out of tolling operations[3] that in the past have formed a large portion of Russia's alumina refining and aluminum smelting activity. Wholesale electricity rates increased during 2000, which increased smelting costs, although this was offset by de-linking electricity prices from the U.S. dollar. Although some plants had difficulty paying for power and supplies, the production of both alumina and aluminum increased during the year. Alumina production is estimated to be 2.9 Mt (up 7%) and aluminum production is estimated to be 3.3 Mt (up 3%). With the expected lower production in the United States in 2001, it is likely that Russia will become the top-ranking producer of primary aluminum in 2001.

Most of the smelters in Russia plan to expand, partly though modernization, which will also reduce emissions. Proposed new smelters, coupled with brownfield expansions, could raise Russian capacity by over 1 Mt/y. The ownership of the smelters in Russia changed as the amalgamation of the former state-run enterprises continued. Two main groups have consolidated many of the aluminum smelters: Russky Aluminii (or Russian Aluminium) and Sual-Trastkonsalt.

At the end of 2000, Russky Aluminii (an amalgamation of Sibirsky Aluminium's assets with the aluminum interests of Sibneft Oil) had 2.1 Mt/y of aluminum production capacity in the Bratsk, Krasnoyarsk and Sayansk smelters. The company also has interests in the Novokuznetsk smelter and in the Achinsk (Russia), Mykolayivsky (Ukraine), Yugoslavian and Romanian alumina refineries, as well as in other downstream facilities.

Russky Aluminii abandoned its participation in a proposed new 260 000-t/y smelter in Irkutsk to increase efficiencies at the Krasnoyarsk and Bratsk smelters. The company planned to spend US$120 million over the next 10 years to reduce emissions and modernize the facilities, including a switch to prebaked anodes at its 835 000-t/y Krasnoyarsk smelter. The company expected production to increase by 50 000 t/y as a result of this work. At the 900 000-t/y Bratsk smelter, which is the largest smelter in the world, facilities will also be automated and converted from Soderberg to prebaked anode technology. The company planned, as an interim step, changes to the composition of anode paste to reduce emissions. It also planned to increase the production of semi-fabricated and fabricated products, and to undertake modernization programs at the Novokuznetsk smelter, at both its alumina plants (Achinsk in Russia and Mykolayivsky in Ukraine), and at its bauxite mines.

In April, Sibirsky Aluminium (now associated with Russky Aluminii) announced a five-year plan to increase the capacity of the Sayansk smelter in Siberia from 400 000 t/y to 650 000 t/y. The company also conducted studies for a new 250 000-t/y smelter at Pervomaisk in Ukraine – one of the conditions for the purchase of the Mykolayivsky alumina refinery. Construction could start in 2002. (Sibirsky has an Internet site at http://www.sibirskyaluminum.com.)

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[3] In a tolling agreement, the plant processes material owned by others for a fee. The transition to reduce tolling by the smelters and refineries results in increased capital requirements to finance and carry the inventories, which increases costs. As companies move from tolling operations, management of the smelters has to be increasingly focused on product marketing and obtaining/purchasing supplies.

The Siberian-Urals Aluminium Company-Trastkonsalt group (SUAL) was formed through an amalgamation of SUAL with Trastkonsalt interests. At year-end, SUAL had 0.5 Mt/y of aluminum smelting capacity at the Irkutsk, Bogoslovsk, Uralsk and Kandalsksha smelters, interests in the Uralsk and Bogoslovsk alumina refineries in the Sverdlovsk region, and bauxite mines.

SUAL obtained a US$100 million loan from Sberbank to further develop its bauxite mines, primarily through the construction of a 160-km railway that is expected to take two years to complete. The railway will facilitate the transport of bauxite from a new bauxite mine at Sredne-Timan in the Komi Republic, which is currently accessible via an ice road only. SUAL is expanding its alumina operations to 700 000 t/y by 2002 and expected that its capacity will eventually reach 6.5 Mt/y. The company also studied the construction of a US$600 million-$700 million, 1.5-Mt/y alumina plant in Ukhta, Komi Republic.

Also a part of SUAL, Irkutsk Aluminum Works planned to upgrade its smelter over the next five years and to add a fifth potline once financing is obtained. Its capacity would be raised by 75 000 t/y with this addition.

Early in 2001, SUAL and Pechiney discussed cooperation in upgrading SUAL's operations from bauxite mining, through alumina refining and primary production, to rolling facilities.

The Leningrad Nuclear Power Station has excess power capacity and the regional government explored options with potential investors in new smelters near St Petersburg in the Leningrad region. Volkhov Aluminum discussed with potential partners an increase of its smelting capacity from its current 22 000 t/y. Volkhov wishes to either expand the existing smelter or build a new greenfield 150 000-200 000-t/y smelter in the Leningrad area of northwestern Russia. The cost of the smelter would be approximately US$400 million. Alutec Inc., a U.S.-based management consulting company, also started a prefeasibility study for a 220 000-t/y smelter in the Leningrad region, near Sosnovy Bor. The study was expected to be completed in early 2001. The project would cost approximately US$800 million and take two years to construct once financing and a positive decision are obtained.

The Russian National Aluminium and Magnesium Institute (VAMI) expected to complete a feasibility study in early 2001 for a new aluminum smelter with a capacity of 300 000 t/y in the Irkutsk region. The study was originally started for Russky Aluminii; however, when that company dropped out of the project, a new company, Alucom-Taishet, took over the study. Alucom-Taishet planned to start construction on a small experimental smelter in 2001.

Azerbaijan

The Government of Azerbaijan merged its aluminum assets in the Sumgait Non-Ferrous Metals plant, in a non-operating 25 000-t/y aluminum smelter, in Ganga Alumina, and in another mining company into one single company (Azeralyuminii) in preparation for seeking additional investment and possible privatization. After a tender process, the government appointed Fondel Metals International B.V., a Dutch trading company, to manage the amalgamated company and to start feasibility studies into re-opening the smelter and expanding the alumina refinery to 450 000 t/y. The refinery uses alunite and bauxite as sources for the alumina production.

Slovakia

The Board at Slovakia's Slovalco A.S. aluminum smelter at Ziar-nad-Hronom approved a US$80 million expansion from the current 105 000 t/y to 155 000 t/y. Construction was expected to start in mid-2001 and would take two years to complete. The company also planned to increase capacity for the production of semi-finished products after the smelter was expanded. At year-end, Slovalco was owned by Zavod Slovenskeho Narodneho Povstania O.S. (ZSNP), 75.5%; Norsk Hydro, 14.5%; and the European Bank for Reconstruction and Development (EBRD), 10%. Early in 2001, the government planned to sell part of its interest to EBRD and Norsk Hydro. (Additional information is available on the Internet at http://www.slovalco.sk, http://www.zsnp.sk and http://www.ebrd.com.)

Slovenia

In 2000, Kidricevo Talum d.o.o. planned to spend US$110 million to increase its smelter capacity from 75 000 t/y to 155 000 t/y. The company obtained a loan to fund part of the modernization of its existing facilities and the construction of a new potroom. Work was expected to be completed by 2003.

Ukraine

The Government of Ukraine also took measures to stop illegal sales of aluminum and, in June, banned exports of unprocessed nonferrous scrap. The government also continued with plans to partly privatize its alumina and aluminum interests.

The government held a tender for 68.01% of the state-owned aluminum producer, Zaporizky Aluminiyevy Kombinat (Zaporozhye), which operates a 110 000-t/y smelter in southern Ukraine and a 240 000-t/y alumina refinery. In early 2001, the government announced that it had agreed to sell 68.01% of the company to AvtoVAZ-Invest. AvtoVAZ-Invest will invest US$200 million in upgrading the facilities as Zaporozhye planned to expand production to

200 000 t/y by 2006. Employees own 6.99% of the company and the government planned to keep its remaining 25% interest. Kaiser Aluminum & Chemicals had earlier completed a study on improving the smelter's environmental performance, including a conversion from Soderberg to prebake technology. The cost of the program to raise production capacity to 157 000 t/y was estimated at US$200 million. Earlier, Zaporozhye signed an agreement with Sibirsky to cooperate in production and sales of alumina. (Additional information is available on the Internet at http://packet.zp.ua/online/zalk.)

The Government of Ukraine announced that it would privatize 30% of the Mykolayivsky Hlynozemny's Zavod alumina plant (Nikolaev). Ukrayinsky Aluminium (associated with Sibirsky Aluminium/Russky Aluminii interests) subsequently won the tender and completed the US$100 million purchase. It then purchased additional shares of Nikolaev on the market and an additional 10% auctioned by the government in November. At year-end, the other shareholders were reported as Sibirsky Aluminium (36%), the government (10%) and employees (9%). Ukrayinsky Aluminum started studies for the construction of a new 130 000-t/y aluminum smelter in Ukraine, at an estimated cost of US$190 million, to fulfil its commitments on the Nikolaev purchase. Other commitments included modernization and an increase in refinery capacity to 1.3 Mt/y from 990 000 t/y, the assumption of some of the refinery's debts, and the purchase of bauxite mines in Guinea. Nikolaev produced a record 1.115 Mt of alumina in 2000 and production was to be increased to 1.2 Mt in 2001.

Kazakhstan

The Government of Kazakhstan imposed a 4% export tariff on scrap and recycled aluminum. The minimum tariff is US$25.73/t. The government also expected to privatize its remaining 31.7% ownership in Aluminum of Kazakhstan as part of its privatization program.

Aluminum of Kazakhstan planned to increase the capacity of its Pavlodar alumina refinery to 1.5 Mt/y by 2005. In addition, the company completed a feasibility study for a new US$1.2 billion, 215 000-t/y smelter, also in Pavlodar. The company sought funding for this work from investors and, once obtained, plans to begin the project for which construction was expected to take two to three years. In conjunction with these expansions, the company bought new mining equipment to increase the stripping of overburden and production at its Krasnooktyabrskoye bauxite mine.

Middle East

The rapid pace of upgrading and expansion of the aluminum industry in the Middle East continued. Companies have proposed a number of expansions to existing facilities and have renewed discussions on previously proposed greenfield smelters. Work continues on feasibility studies and financing for most of these proposals and includes the following:

- **Dubai** Aluminium Company Limited (Dubal) started studies for a new expansion called the Heron project to increase the capacity of its smelter at Jebel Ali by 75% to 936 000 t/y. The current capacity of 536 000 t/y was reached last year after completion of its earlier Condor project expansion. The estimated cost of Heron is US$1.8 billion. The expansion of this smelter could start in 2001. (Dubal has an Internet site at http://www.dubal.co.ae.)

- In **Oman**, studies for a proposed US$2.5 billion, 480 000-t/y aluminum smelter at Sohar were completed. Contracts were issued for a gas pipeline from central Oman to Sohar that would supply the proposed smelter. The pipeline is to be completed in 2002. Discussions continued with potential partners.

- Aluminium **Bahrain** B.S.C. (Alba) continued construction of a 450 000-t/y coke calcining plant and the upgrading of other facilities at its smelter in Ras Zurrayed. The US$400 million project remained on schedule for start-up in mid-2001. Late in the year, the Government of Bahrain approved a US$1.1 billion program, in principle, to cut costs and expand the smelter from its current capacity of 500 000 t/y to 750 000 t/y. If the financial study is positive, construction could start in 2001 with completion in 2004. (Alba has an Internet site at http://www.aluminiumbahrain.com.)

Asia

China's production of primary aluminum for 2000 is estimated at 2.8 Mt, up 9% from 1999's production of 2.599 Mt following an 11% increase in 1999. This makes China the third largest primary producer in the world. By 2001, with the expected expansions in China and closures in the United States, China is expected to become the second largest aluminum producer in the world. Global Trade Information Services, Inc., publisher of the *World Trade Atlas*, reports that imports of unwrought aluminum (HS 7601) to China were up 71% to 914 130 t in 2000 while exports were up only up 1% to 209 112 t.

The government continued to reorganize its interests in the aluminum industry during 2000. The China Aluminium Corporation (Chalco) was disbanded and the assets were restructured to form the Aluminum Corp. of China (Chinalco). Some assets of Chalco were turned over to regional authorities; Chinalco was left holding six smelters and China's alumina refineries, which produce 4 Mt/y of alumina and 675 000 t/y of aluminum. The company planned to seek stock exchange listings in 2001 to raise additional funding to finance new projects.

China is still a net importer of alumina and aluminum despite the Chinese aluminum industry's efforts to fill this gap over the last five years (Figures 7, 8, and 12). The government continued its efforts to reduce pollution, instructing all smelters to convert to prebaked anodes and to reduction cells with higher current intensities (over 60 000 amps) by 2003. These efforts have resulted in the closure of some small plants, while other plants have expanded or are planning to expand to meet the government's minimum size requirements.

Reported work to increase primary smelting capacity in 2000 included:

- Baise Yinhai Aluminium Co. started construction of a new 52 000-t/y smelter in Guangxi Province;
- Baotou Aluminium started construction on a 50 000-t/y expansion of its capacity to 160 000 t/y;
- Guangxi Yingahai Aluminium Works started construction of a new 55 000-t/y smelter in Guangxi Province;
- Henan Shenhuo Aluminium Power Company completed a capacity expansion to 60 000 t/y from 17 000 t/y;
- Lanzhou Aluminium Co. began construction of a 100 000-t/y smelter in Lianhai, Gansu;
- the Qingtongxia Aluminium smelter in Ningxia continued work on an expansion to 230 000 t/y from 100 000 t/y;
- Sanmenxia Aluminium Works expanded capacity by 32 000 t to 66 000 t/y;
- Taiyuan Aluminium Works in Shanxi started an 80 000-t/y expansion to raise capacity to 111 000 t/y;
- Yichuan Power Group and Xinyuan Industry expected to start construction on a new 100 000-t/y smelter using 300 kA technology in mid-2001 with production to start in 2003;
- the Yunan Aluminium plant completed an expansion from 85 000 t/y to 130 000 t/y;
- the Xiezhou Aluminium plant in Shanxi completed a 40 000-t/y expansion; and
- the Zunyi Aluminium plant in Guizhou was expected to start construction on a 100 000-t expansion to 132 000 t/y in early 2001.

The alumina industry continues to expand, and reported work on expansions and new projects included:

- Pingguo Aluminium Co. obtained approval to double its alumina production capacity to 800 000 t/y and was expected to complete the expansion in 2003;
- Guizhou Aluminium Co. worked on expanding its capacity from 400 000 t/y to 500 000 t/y with completion expected early in 2001;
- the Shandong Aluminium plant completed an expansion to 770 000 t/y;
- Great Wall Aluminum Company worked on an expansion from 800 000 t/y to 1.0 Mt/y;
- the Zhongzhou Alumina plant was working on debottlenecking and an expansion from 300 000 t/y to 450 000 t/y;
- the Guangxi government studied a new 700 000-t/y alumina refinery in Baise and a 100 000-t/y smelter; and
- the city of Nanchuan completed a feasibility study for a 150 000-t/y alumina refinery.

Norsk Hydro ASA opened an extrusion plant, Hydro Aluminium Wuxi, near Shanghai. The plant has a capacity of 2000 t/y and expects to expand to 4000 t/y if sales warrant.

In **Indonesia**, water shortages again reduced the power available to Nippon Asahan Aluminum Co. Ltd.'s Indonesian smelter. At year-end, the smelter was running at 80% of its capacity of 225 000 t/y; the company expected to reach full capacity in 2001.

In mid-2000, Alcan Taihan Aluminum Limited acquired a 95% interest in Aluminium of **Korea** Limited (Koralu) for US$200 million in cash and the assumption of US$95 million in debt. Alcan Taihan expects to double its capacity to 600 000 t/y with a US$100 million-$200 million expansion program in anticipation of expected growth in aluminum casting and rolled products in the region.

Pechiney continued studies on a potential US$1 billion bauxite mine and alumina refinery near Ho Chi Minh City, Landong, in southern **Vietnam**. The project would produce 1 Mt/y of alumina. Transportation infrastructure and power supplies would be required for this new greenfield facility.

The Perak State Development Corporation studied a 500 000-t/y smelter in **Malaysia** and held discussions with potential partners for the project. The facility, near Lumut in Perak State, could cost US$2 billion. Construction could start in 2001 if power supplies can be obtained.

Africa

Billiton Plc completed construction of the 250 000-t/y Mozal smelter in Maputo, **Mozambique**, and the first aluminum was produced in June. The US$1.3 billion smelter was expected to reach its capacity in early 2001. The smelter uses Pechiney AP30 technology, duplicating Billiton's Alusaf Hillside facility in South Africa. It has been designed to easily add a second potline to double its capacity to 500 000 t/y, and Billiton announced that approval had been obtained to conduct feasibility studies for expansions at Mozal (250 000 t/y) and Hillside (125 000 t/y) in **South Africa** where Billiton is installing graphitized electrodes to improve production. Both feasibility studies were expected to be completed in early 2001 and, if positive, construction would take a further 18 months. The Mozal smelter is owned by a joint venture comprising Billiton plc (47%), Industrial Development Corporation of South Africa Ltd. (24%), Mitsubishi Corporation (25%) and the Mozambique government (4%). (Further information on the Mozal project is available on the Internet at http://www.mozal.com.)

The Government of **Guinea** conducted feasibility studies for its proposed Sangarédi alumina greenfield refinery in Boké. The 2.4-Mt/y plant was expected to cost US$2.4 billion. Studies were expected to be completed in mid-2001; if a positive decision is obtained, construction would take five years. The government also discussed management of its bauxite mines with Russky Aluminii, a major user of that bauxite.

The Alumina Company of Guinea started a feasibility study to increase capacity at the Friguia alumina refinery to 1 Mt/y from its current capacity of 640 000 t/y. A decision on the project was expected in mid-2001.

India

In 2000, the Government of India decided to privatize the Bharat Aluminium Company Limited (Balco) and restructured the debts and its ownership in the company to facilitate the sale. Balco operates a 200 000-t/y alumina refinery and a 110 000-t/y smelter in Korba, in the state of Madhya Pradesh. The government planned to sell its interest in three phases and expected to sell the first 51% interest in early 2001. A decision between bids from Sterlite Industries (India) Limited and a joint bid from Alcoa Inc. and Hindalco Industries Limited (Hindalco) was expected in early 2001, although the Chattisgarh state government and company employees had reservations about the sale. The government expects the new owner to upgrade Balco's facilities.

National Aluminium Company Limited (Nalco) continued work on the expansion of its smelter capacity at Angul to 345 000 t/y from 230 000 t/y and expected the plant to be completed in mid-2002. The Government of India approved construction of a 120-MW power plant to provide additional power for this smelter expansion. Work also continued to double the capacity of its bauxite mines at Panchpatmalli to 4.8 Mt/y and to increase the capacity of its alumina refinery at Damanjodi to 1.57 Mt/y from 0.8 Mt/y. Work on these expansions is expected to be completed in 2003. Nalco also acquired International Aluminium Products Ltd., a 50 000-t/y rolling operation, located near the Nalco smelter in Orissa.

Hindalco Industries Limited (Hindalco) purchased Alcan's 54.62% interest in Indian Aluminium Company, Limited (Indal) for approximately US$165 million. Hindalco purchased an additional 20% interest of the publicly traded shares, via the Internet, for a cost of US$60 million. Hindalco has been actively integrating its operations, including:

- Indal has moved some pots from the closed Belgaum smelter in Karnataka to Hirakud to increase that smelter's capacity to 60 000 t/y. It also studied the feasibility of moving the remaining equipment from Belgaum to further increase the capacity.
- Hindalco's expansion of its Renukoot smelter and alumina facilities in Uttar Pradesh State is proceeding. The Renukoot aluminum smelter will be expanded to 342 000 t/y from its current 240 000 t/y; the captive alumina capacity will be raised by 210 000 t/y from its current capacity of 450 000 t/y; and power generation will increase to 769 MW from 619 MW. Hindalco planned to start production at the smelter in early 2001. The US$575 million expansion is expected to be completed in 2002. (Additional information is available on the Internet at http://www.adityabirla.com and http://www.indal.com.)

Alcan and Hydro Aluminium a.s. continued work on a proposed US$1 billion export-oriented alumina project. Although construction was to start in 2001 and the project was expected to be completed in 2005, the level of project activity was reduced to allow local communities to participate in ongoing discussions and planning for the project. Alcan has provided the technical services for the feasibility study and the technology for the proposed joint venture to be known as Utkal Alumina International Ltd. The proposal is to mine bauxite at Baphilmalli, set up a power plant, and construct a first-phase, 1-Mt/y greenfield alumina plant in the Rayagada region of Orissa. A second phase could increase capacity to 2.5 Mt/y.

The state government in Andhra Pradesh studied a project that includes a bauxite mine with a capacity of up to 3 Mt/y, a 1-Mt/y alumina refinery and a 250 000-t/y smelter. However, the local community objected to the proposal and the required land transfer, and it was expected that the project would not proceed. (Additional information is available on the Internet at http://www.andhrapradesh.com.)

Australia

Comalco Limited decided on a Queensland location for a proposed 1.4-Mt/y alumina refinery and conducted a final feasibility study on constructing the plant in Gladstone. The refinery was expected to cost US$830 million and to take 30 months to construct. A decision on construction was expected in early 2001. Comalco indicated that it would build the project to be easily expanded to 4 Mt/y. Energy supplies will be needed for the plant, which could be provided by a proposed pipeline for Papua New Guinea gas. The federal and state governments have offered A$350 million in government funding for the facility. During the year, Rio Tinto plc purchased the remaining 28% interest in Comalco that it did not already own. (Additional information is available on the Internet at http://www.comalco.com.au/, http://www.isr.gov.au, http://www.riotinto.com and http://www.statedevelopment.qld.gov.au.)

Aldoga Aluminium Proprietary Ltd. conducted studies on a US$1.6 billion, 500 000-t/y smelter to be located near Aldoga, 25 km west of Gladstone, Queensland. The company held discussions with Alcoa for technology and with the State for the required 800 MW of power. If successful, the company hopes to have construction completed in 2002.

Early in 2001, Alcan completed the purchase of a 30% interest from CSR Ltd. and AMP Life Ltd. in the 1.8-Mt/y Gove alumina refinery and bauxite mine in Northern Territory and it now owns all of the Gove refinery. The US$393 million purchase resulted from a right of first refusal from Alusuisse's partnership in Gove Aluminium Ltd. with CSR and AMP and followed an earlier agreement for the sale between CSR and Billiton. The Gove facilities offer Alcan an opportunity to maintain its low-cost supplies of bauxite and alumina along with opportunities for expansion. An expansion of the refinery to 2.0 Mt/y is currently under way.

Pechiney signed an Option to Purchase Agreement on the purchase of a 15.5% interest in the Tomago smelter in New South Wales from AMP Life Ltd. for US$220 million. When exercised, Pechiney will hold 51.55% of the smelter. (Additional information is available on the Internet at http://www.tomago.com.au.)

Alcoa of Australia Limited, owned jointly by WMC Limited (39.25%) and Alcoa Inc. (60%), restarted 40 000 t/y of idled capacity at the 345 000-t/y, Alcoa-operated Portland aluminum smelter in Victoria, bringing it up to full operating capacity. After receiving government approvals, Alcoa purchased Eastern Aluminium for US$108 million. Eastern holds a 10% interest in the Portland smelter.

Alcoa also restarted 20 000 t/y of idled capacity at its wholly owned 180 000-t/y Point Henry smelter, bringing that smelter up to its full operating capacity.

In January 2001, Alcoa completed the US$1.49 billion sale of Reynolds Australia Alumina, Ltd. LLC, which holds Reynolds' 56% interest in the Worsley alumina refinery in Western Australia, to Billiton Plc. Billiton now owns an 86% interest in the refinery; the remaining 14% is owned by Kobe Alumina Associates (Australia) Pty Ltd., Nissho Iwai Alumina Pty Limited and Itochu Corp. Worsley Alumina Pty. Ltd. completed an expansion of the refinery's capacity to 3.1 Mt/y from 1.8 Mt/y in mid-2000. Worsley Alumina expects this facility to be the lowest-cost alumina refinery in the world. (Additional information is available on the Internet at http://www.wapl.com.au and www.alcoa.com.)

VAW Aluminium AG purchased the 150 000-t/y Kurri Kurri smelter, located in New South Wales, from Capral Aluminium Limited for US$288 million. VAW planned to expand the smelter's capacity to 165 000 t/y from 150 000 t/y by 2003. (The companies have Internet sites at http://www.capral-aluminium.com.au and http://www.vaw.de.)

RECYCLING

Recycled aluminum is often referred to as "secondary" aluminum. While this latter terminology reflects a use beyond the primary use and production, the term is confusing to many people as aluminum can be recycled many times and the product obtained and used in new products meets the specifications of new material for that application. The use of "secondary" has thus been replaced in this publication by "recycled."

When used in most applications, the aluminum metal is not destroyed or consumed by the application. The metal and the energy inherent in the scrap and used products, both industrial and consumer, remain valuable resources. The recycling of aluminum requires less than 5% of the energy used to make the original metal. As a result, energy represents only 2% of an aluminum recycling smelter's operating cost compared to 22-30% for a primary smelter. As an example, the recovery of 2 kg of aluminum from used material (compared to primary production) saves more electricity than that used in one day in an average Canadian home using an alternative heat source. (Details on Canadian household energy consumption are available on the Internet at http://oee.nrcan.gc.ca.)

The automotive industry is the largest user of recycled aluminum, using some 80% of recycled production. As requirements and demand for lighter vehicles increase, it is likely that demand for recycled aluminum and automotive alloys will also increase significantly.

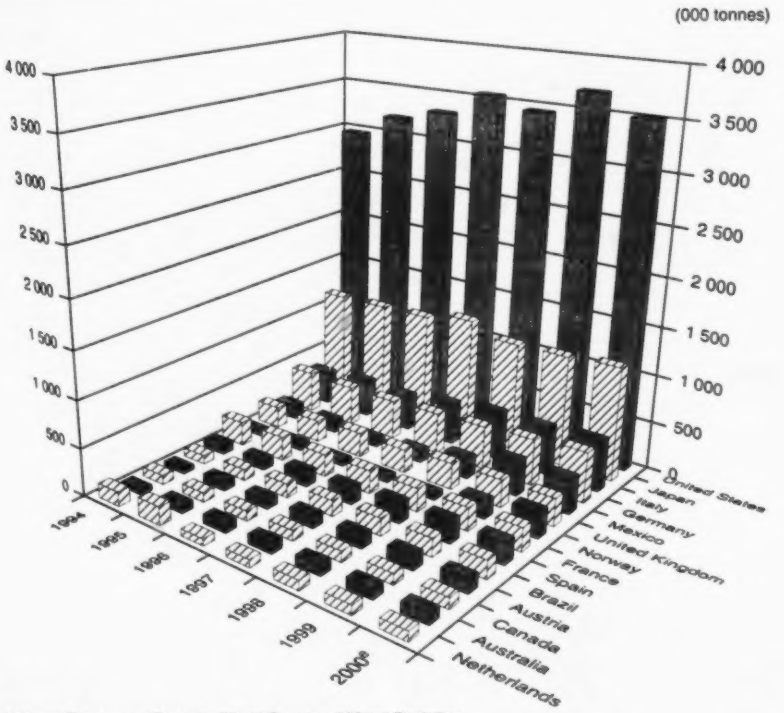
There has been a general increase in recycled aluminum production attributable to continued improvements in scrap collection systems and increased recycling of consumer products. The World Bureau of Metal Statistics reports Western World production of recycled aluminum on a monthly basis. Production increased slightly to an estimated 8.2 Mt in 2000, compared to a reported 8.1 Mt in 1999. (The World Bureau of Metal Statistics has an Internet site at http://www.wbms.dircon.co.uk.)

In 2000, the largest recycled aluminum producers were the United States with an estimated 3.4 Mt, Japan with 1.2 Mt, and Italy and Germany with 0.6 Mt each.

Canadian companies recycle aluminum from both post-consumer materials and scrap produced in production and manufacturing processes. Significant quantities of recycled aluminum, generally in ingot or liquid metal form, are used in the production of semi-finished and finished products. In addition, there is significant trade in scrap between Canada and other countries. Canada is a net exporter of scrap.

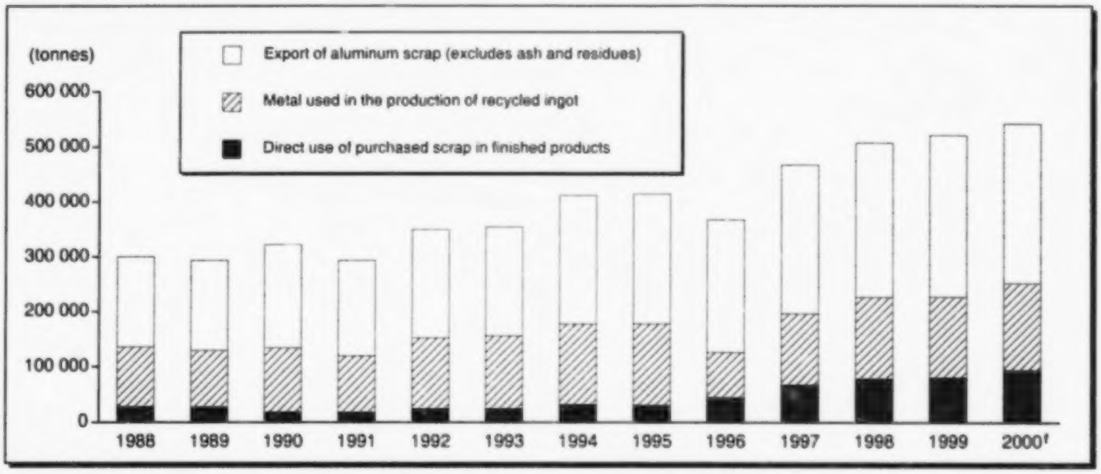
Reported Canadian use of outside scrap (i.e., scrap aluminum obtained from other companies) for the direct production of semi-finished or finished products was 80 689 t in 1999, up from a revised figure of

Figure 5
Production of Recycled Aluminum, 1994-2000
Top 14 Countries (96% of Total Amount Recycled)



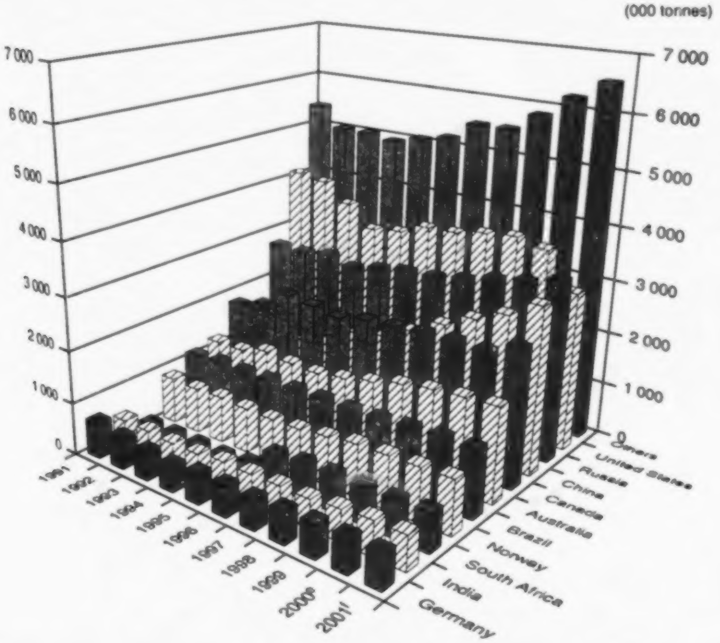
Sources: Natural Resources Canada; World Bureau of Metal Statistics.
e Estimated.

Figure 6
Recycling of Aluminum in Canada, 1988-2000



Source: Natural Resources Canada Annual Survey of Aluminum Metal Use in Canadian Establishments.
f Forecast.
Notes: Export figures are obtained from Canadian government trade data. Data on metal use are obtained from responses to questionnaires sent to aluminum-using companies. In 2000, over 160 Canadian companies used primary, recycled and scrap aluminum. Companies surveyed include: primary metal producing, recycling, casting, rolling, extruding and foundry operations.

Figure 7
Primary Aluminum Production, Top 10 Producers, 1991-2001



Sources: Natural Resources Canada; World Bureau of Metal Statistics; International Consultative Group on Nonferrous Metals Statistics; International Primary Aluminium Institute.
e Estimated; f Forecast.

78 298 t in 1998. The use of outside scrap in 2000 is estimated to be above 94 000 t. The reported use of purchased recycled aluminum ingot was 199 429 t in 1999 compared to 158 355 t in 1998. The reported use of aluminum metal, including scrap used in the production of recycled aluminum ingot, was 145 959 t in 1999, down from the 147 847 t used in 1998. The estimated quantity used for this purpose in 2000 is 157 794 t (Table 1a).

Although there are no major facilities in Canada to remelt used aluminum beverage cans (UBC) and reform the metal into new can sheet, UBCs are collected and shipped to facilities in other countries. For example, in 1999, about 1.5 billion scrap aluminum cans were recovered and exported to the United States to be recycled into can sheet. This represents approximately 45 000 t of aluminum.

PRODUCTION AND USE

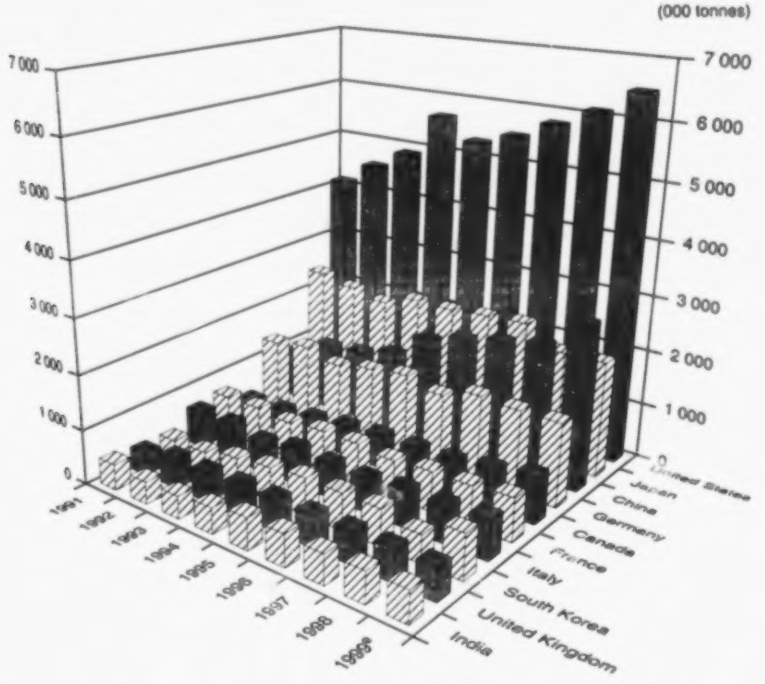
World production of primary aluminum increased to 23.7 Mt in 1999, up from 22.6 Mt in 1998. World production in 2000 is estimated to have increased by over 3% to 24.4 Mt. Western World production is expected to increase to over 17.5 Mt in 2000, up from 17.2 Mt in 1999. Primary aluminum production in 2000 is expected to be 3.9 Mt in Western Europe, 3.7 Mt in the United States and 3.3 Mt in Russia. Recent production and capacity increases have occurred in China, Russia and Australia; the most notable decrease occurred in U.S. production (Table 8).

Total world use of primary aluminum was 23.8 Mt in 1999, about 8% higher than the 22.0 Mt recorded in 1998.

Technology

The production processes for aluminum from bauxite are well documented in most encyclopedia and many web sites, which can be found through any search engine (see, for example, http://www.worldaluminium.org).

Figure 8
Apparent Use of Primary Aluminum, Top 10 Countries, 1991-99



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
e Estimated.

In general, the Hall-Héroult method of smelting aluminum discovered in 1886 has been refined since discovery to reduce emissions and pollution and increase efficiency. Some of the recent gains in efficiency have been obtained through the use of larger cells with higher electrical current density. In 2000, Pechiney announced plans to offer its new AP50 technology, which will use 500 kA amperage in cells, up from the currently used 300+ kA in AP30 technology. Pechiney expected this cell to achieve current efficiency of 95-96% and to reduce both operating and capital costs. The technology was expected to be available for new smelters that started construction in 2001.

During 2000, several announcements were made and patents were issued on new technological advances, inert anodes and wettable cathodes that, when perfected, will further improve the process. Alcoa has been a leader in this research and has indicated that it will be conducting trials in commercial cells with its new anode materials in early 2001. If successful, efficiencies could be increased by 10-20% and production costs could be reduced by 10-20% with less greenhouse gas generation. It may be several years before such technology becomes feasible on a wide scale. (Additional information is available on the Internet at http://www.alcoa.com or http://www.oit.doe.gov.)

Research continues on other methods of production. For example, the University of Ohio announced that it had received patents to apply fuel cell technology to aluminum smelting. The process would use natural gas in zirconia tubes to directly reduce the alumina with significant power and emissions reduction. Additional research is required to perfect and apply this development to commercial smelters.

OCCURRENCE, CHARACTERISTICS AND USES

Aluminum is the most abundant element in the earth's crust (estimated at 8% of it). Aluminum does not occur naturally in its native (metal) or pure state, but is found in oxides, hydroxides, halides, sulphates, silicates and as complexes with organic matter.

Both igneous and sedimentary rocks can contain up to 20% aluminum, predominantly in the form of aluminum silicates. Aluminum-containing silicates are also a major component of soils (contained in clay minerals, sand and rock fragments), glacial tills and the underlying bedrock. The aluminum content of C horizon soils and glacial tills averages approximately 8% and ranges from 3.5% to more than 10%. Although other minerals can be, and are, used for aluminum production, aluminum oxide, combined with water and other impurities and known as bauxite, is the main ore of aluminum.

Aluminum compounds move through the environment by both anthropogenic (human) activities and natural processes. The quantity of aluminum moved by natural processes far outweighs the direct anthropogenic redistribution of nonmetallic aluminum in the environment. The chemistry of aluminum in the environment is complex and dependent on many factors. The mobility and subsequent transportation of aluminum ions and compounds are dependent on various factors, including the geological weathering environment, chemical speciation (form), soil-water interaction, other elements and compounds present, and the composition of the underlying bedrock. The mobilization of aluminum compounds in the environment by human activity results predominantly from often distant activities that produce acidic precipitation. In general, a lowering of pH results in the increased mobility of some forms of aluminum.

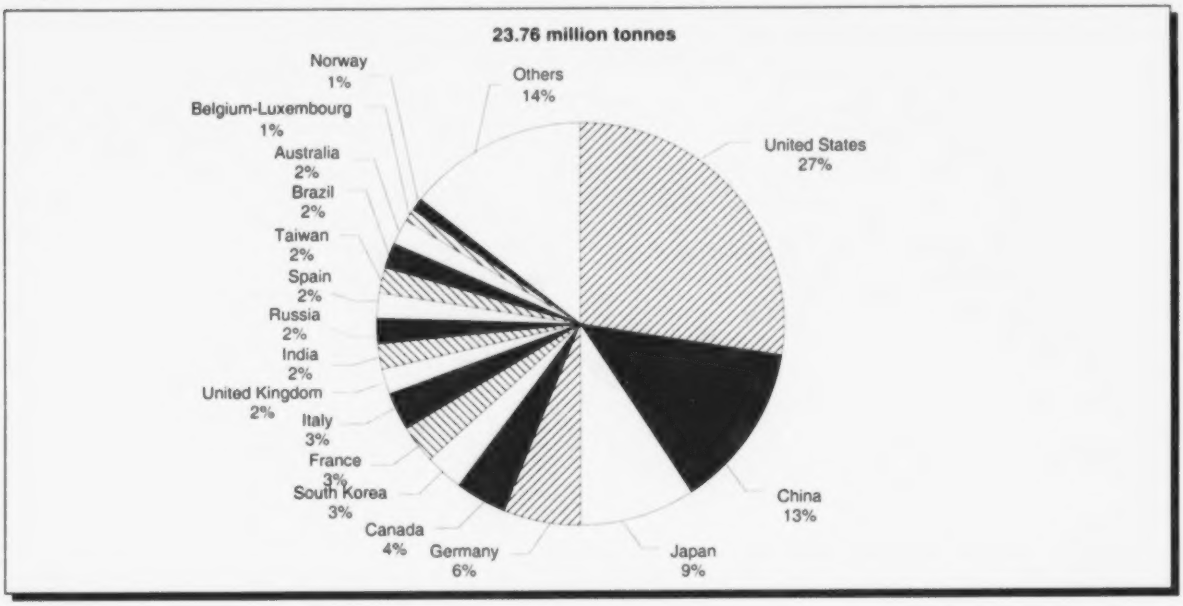
Pure aluminum is a silver-white, malleable, ductile metal with one third the density of steel. Aluminum's dull lustre results from a thin coating of oxide that forms instantly when it is exposed to air. The oxide, which adheres tightly to the metal, accounts for aluminum's resistance to corrosion. Gram for gram, aluminum has twice the electrical conductance of copper. Aluminum is also an efficient conductor of heat and a good reflector of light and radiant heat.

Combining metallic aluminum with other metals produces alloys with enhanced characteristics and increased versatility. The most common metals used in aluminum alloys are copper, magnesium, manganese, silicon, lithium and zinc. Aluminum's tensile strength, hardness, corrosion resistance, and heat-treatment properties improve when alloyed with one or more of these metals. The tensile strength of some copper-aluminum alloys, for example, can exceed that of mild steel by as much as 50%.

Aluminum, in both its pure metallic and alloyed form, is used to make a wide variety of products for the consumer and capital goods markets. Aluminum's largest markets are transportation (29%), packaging (22%), building and construction (13%), electrical (7%), consumer goods (7%), and machinery and equipment (6%). Geographically, North America accounted for 32% of total world demand in 1999 while Asia accounted for 31% and Europe for another 29%. The United States uses the largest amount followed by China and Japan.

The substitution of aluminum for iron and steel in automobile manufacturing helps reduce weight while maintaining vehicle size. Fuel use and, consequently, greenhouse gas emissions are decreased. The lowered weight can also increase safety by reducing stopping distances and improving cornering. Transportation uses are one of the fastest-growing areas of aluminum use, growing at a rate of about 4%/y.

Figure 9
Major Aluminum-Using Nations, Total Apparent Use of Primary Aluminum, 1999



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.

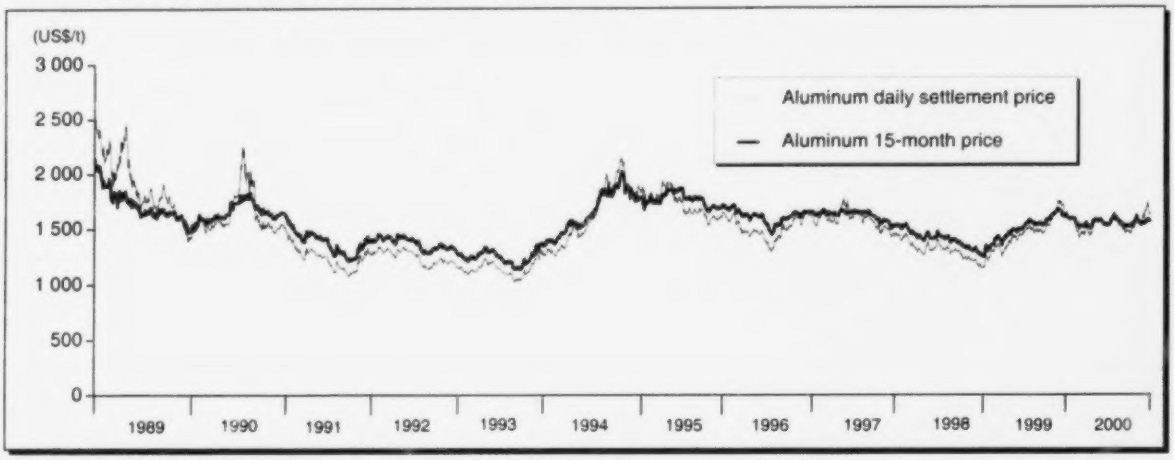
Demand for automotive aluminum is expected to increase from about 110 kg of aluminum per vehicle now to over 150 kg or more within 10 years. This demand will likely be fueled by petroleum price increases and by the number of government and joint government-industry initiatives around the world to focus attention on the ways to reduce automotive weight. Initiatives include the Canadian Lightweight Materials Research Initiative (http://climri.nrcan.gc.ca), the Partnership for a New Generation of Vehicles (PNGV), the Auto Aluminum Alliance (http://www.uscar.org), the Aluminum Association Inc.'s Auto and Light Truck Group (http://www.autoaluminum.org) and the United States Automotive Materials Partnership (USAMP), and the European Council for Automotive Research and Development Agreement (EUCAR).

PRICES AND WORLD OUTLOOK

Large users of aluminum often invest in smelters on a joint-venture basis, taking a share of the metal proportional to their ownership for their own use. These arrangements and others, such as long-term supply agreements between non-related producers and users (such as those between the primary producers and the automotive industry), can provide a certain measure of price stability and certainty for both producers and large users. Through these initiatives and by focusing on value-added operations to produce metal products with higher margins, primary producers can stabilize the short-term volatility of primary aluminum prices to reduce the risk in investment decisions. One side effect of this longer-term planning is that production may be allocated and can make the availability of metal unpredictable on a short-term basis to users with unforeseen needs or to those without such sources.

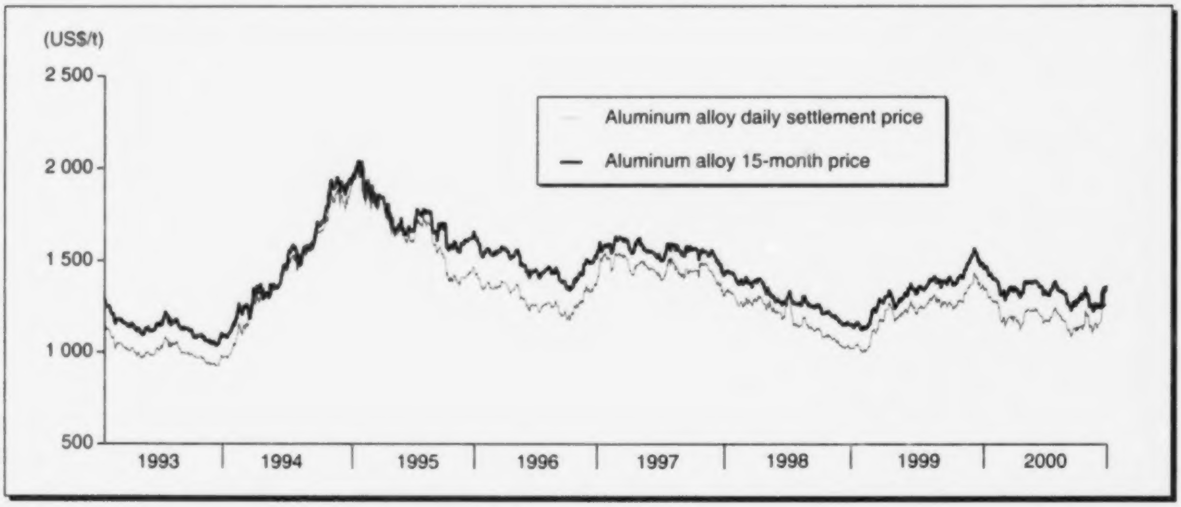
As discussed earlier, cash settlement prices for primary-grade aluminum remained volatile through the year and averaged US$1550/t (US70¢/lb), compared to an average of US$1362/t (US62¢/lb) in 1999. For 2001, continued volatility in aluminum prices is expected. The cash price during the early part of the year has peaked at above US$1700/t, but there is some uncertainty for the rest of the year. On the one hand there is the possibility of metal shortfalls resulting from the U.S. closures while, on the other, net new orders for aluminum mill products fell throughout 2000 and, should this trend continue, along with a reduction in the overall economy, decreased North American demand could cover the production shortfall. As a result, aluminum prices could easily span almost the full expected longer-term price range of between approximately US$1200 and $1800/t (US55¢ and 82¢/lb), although the average price during 2001 may be in the lower portion of that range at about US$1450-$1500/t (US65¢-70¢/lb). Metal prices can be obtained from various news services, journals and

Figure 10
London Metal Exchange Aluminum Prices, 1989-2000



Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

Figure 11
Aluminum Alloy Prices, London Metal Exchange, 1993-2000



Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

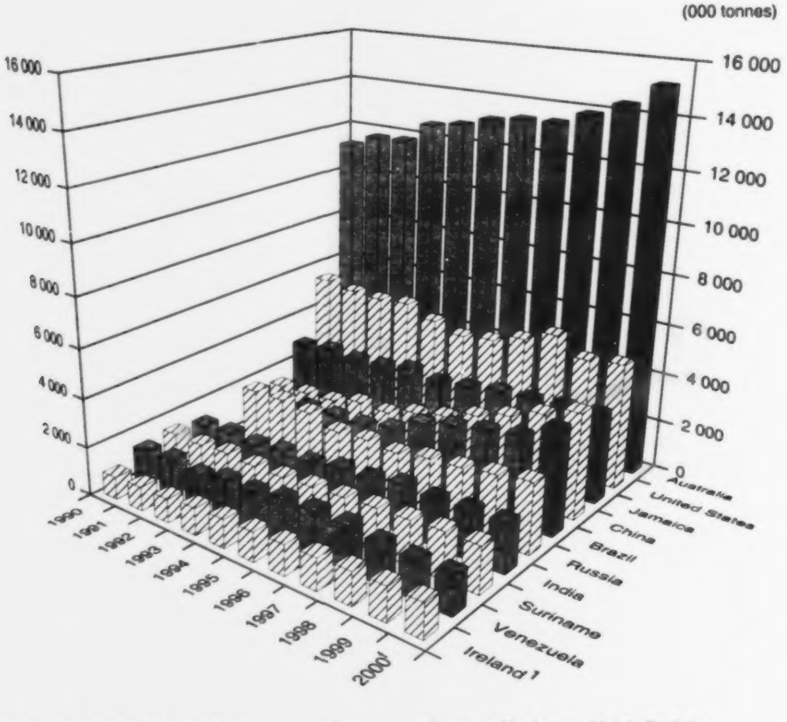
newspapers, as well as from the London Metal Exchange (LME) Internet site at http://www.lme.co.uk and from http://metalprices.com.

Daily settlement prices on the LME for aluminum alloy reflected a weakened general trend of primary aluminum prices. Aluminum alloy settlement prices started 2000 at US$1358/t (US62¢/lb) and have traded in a declining range from US$1438/t (US65¢/lb) established in January to US$1082/t (US49¢/lb) in October, closing the year at US$1143/t. For 2000, alloy prices averaged approximately US$1218/t (US55.3¢/lb), compared to an average of US$1192/t (US54.1¢/lb) in 1999. Aluminum alloy stocks in LME warehouses started the year at approximately 78 000 t and increased steadily to end the year at approximately 88 000 t.

Most alumina is sold on long-term contracts, often at a fixed percentage of the LME metal price, while only a small portion of world production is sold on a cash or spot basis. During the early part of 2000, the spot alumina market continued to feel the impact of the closure of Kaiser's Gramercy plant, but the effect steadily diminished during the year. Spot prices for alumina started the year above US$500/t but steadily declined to the US$160-$180/t level at the end of the year as increases in production from refineries in Australia, Brazil, China and Russia balanced the lost U.S. production. During 2001, prices are expected to remain flat or to trend lower from this level assuming there are no further production disruptions, especially if smelter cutbacks in the western United States are maintained and there are no further cutbacks in alumina production, such as Alcoa's cuts at facilities in the U.S. Virgin Islands and Texas.

World production of primary aluminum increased to an estimated 24.4 Mt in 2000, up 3.2% from the 23.654 Mt produced in 1999. For 2001, world production of primary aluminum is expected to increase by about 2% to 24.8 Mt, which is consistent with

Figure 12
World Alumina Production, Top 10 Producers, 1990-2000
(80% of Total Production)



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; International Primary Aluminium Institute.

f Forecast.

1 Calcined.

aluminum's growth rate over the last 20 years. In the longer term, annual growth of 1-3% is forecast for the early part of this decade. The transportation and packaging markets are expected to lead the increase in demand for aluminum to the year 2005 and perhaps beyond.

IAI figures show that the world primary production capacity of its members is expected to increase about 2.7% to 22.8 Mt in 2001 from 22.2 Mt at the end of 2000, with slightly lower increases in the following years. Taking into account projected increases from non-IAI members, world primary production was expected to rise approximately 2% in 2001.

Notes: (1) Information in this review was current as of February 28, 2001. (2) Lorraine Ralph of the Minerals and Mining Statistics Division prepared Tables 2 and 3 and she and others in that Division have provided assistance in generating the new summary tables on Canadian aluminum. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

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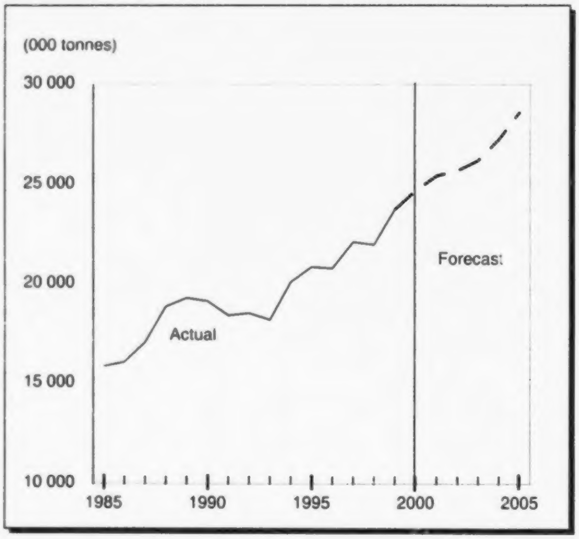
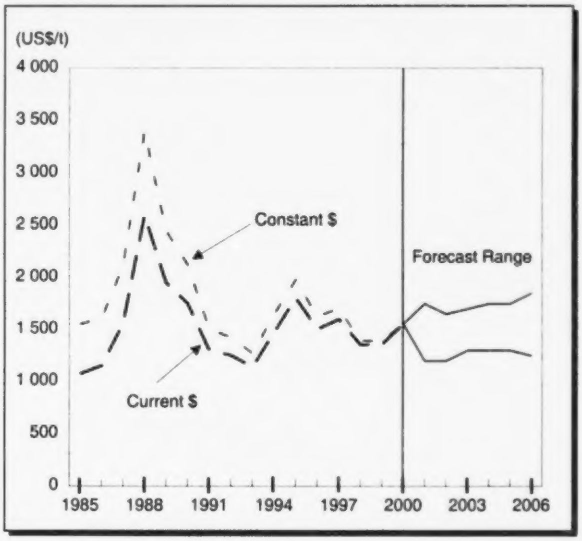
Figure 13
World Primary Aluminum Demand, 1985-2005



Sources: Natural Resources Canada, World Nonferrous Metal Statistics Group.

Figure 14
Aluminum Settlement Prices, 1985-2006



Source: Natural Resources Canada.

TARIFFS

Item No.	Description	Canada			United States	EU	Japan[1]
		MFN	GPT	USA	Canada	MFN	WTO
2606.00.00	Aluminum ores and concentrates	Free	Free	Free	Free	Free	Free
2818.20.00	Aluminum oxide, other than artificial corundum	Free	Free	Free	Free	4.0%	Free
7601.10	Unwrought aluminum, not alloyed	Free	Free	Free	Free	6%	Free
7601.20	Unwrought aluminum alloys	Free	Free	Free	Free	6%	Free
7602.00	Aluminum waste and scrap	Free	Free	Free	Free	Free	Free
76.03	Aluminum powders and flakes	3.5-5%	Free	Free	Free	5.1-5.3%	3%
76.04	Aluminum bars, rods and profiles	Free-5%	Free	Free	Free	7.5%	7.5%
76.05	Aluminum wire	Free-4%	Free	Free	Free	7.5%	7.5%
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	Free-6.5%	Free-5%	Free	Free	7.5%	Free-2%
76.07	Aluminum foil not exceeding 0.2 mm	Free-6.5%	Free-5%	Free	Free	10%	7.5%
76.08	Aluminum tubes and pipes	Free-5%	Free	Free	Free	Free-7.5%	7.5%
7609.00	Aluminum tube or pipe fittings	5.5%	3%	Free	Free	7%	3%
76.10	Aluminum structures (excluding prefabricated buildings of heading no. 94.06) and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	6.5%	5%	Free	Free	6-7%	Free-3%
7611.00	Aluminum reservoirs, tanks, vats and similar containers, for any material	Free-6.5%	Free-5%	Free	Free	6%	3%
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material	6.5%	2.5-5%	Free	Free	6%	3%
7613.00	Aluminum containers for compressed or liquefied gas	6.5%	5%	Free	Free	6%	3%
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	4.5%	3%	Free	Free	6%	3%
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	6.5%	Free-5%	Free	Free	6%	Free
76.16	Other articles of aluminum	Free-6.5%	Free-5%	Free	Free	6%	3%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (40th Annual Edition: 2000); *Custom Tariff Schedules of Japan*, 2000.

[1] WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1a. CANADIAN ALUMINUM PRODUCED AND TRADED, 1999 AND 2000

Item No.		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION		2 389 834	. .	2 373 460	. .
IMPORTS					
2606.00	Aluminum ores and concentrates				
	Brazil	1 840 420	59 773	1 293 334	43 403
	Guinea	150 084	7 941	499 469	20 079
	Australia	493 985	18 630	322 257	12 962
	United States	110 736^r	7 509^r	187 411	11 296
	Guyana	372 917	11 891	244 871	8 747
	Bermuda	–	–	163 096	5 166
	Other countries	95 906	4 842	127 831	6 310
	Total	3 064 048^r	110 586^r	2 838 269	107 963
2620.40	Ash and residues containing mainly aluminum	4 191	4 027	4 213	4 144
2818.20	Aluminum oxide (excluding artificial corundum)				
	Australia	1 633 614^r	401 499^r	1 790 055	497 325
	United States	1 098 207^r	324 150^r	1 205 260	393 017
	Jamaica	632 511	164 319	579 176	159 363
	Brazil	25 591	6 653	89 129	26 003
	Venezuela	–	–	25 315	7 106
	China	8 156	2 887	8 142	4 420
	Germany	1 444	2 724	1 836	3 733
	Austria	1 214	3 552	1 339	2 966
	Other countries	4 694^r	4 472^r	31 237	9 401
	Total	3 405 431^r	910 256^r	3 731 489	1 103 334
2818.30	Aluminum hydroxide	16 337	10 106^r	8 233	6 818
7601.10	Unwrought aluminum, not alloyed				
	United States	46 473^r	101 135^r	42 799	100 649
	Argentina	–	–	1 304	3 516
	Russia	1 110^r	1 964^r	651	968
	Other countries	2 578^r	4 973^r	523	1 330
	Total	50 161^r	108 072^r	45 277	106 463
7601.20	Unwrought aluminum, alloyed				
	United States	184 718^r	334 447^r	215 263	376 504
	Russia	9 531	16 309	12 113	21 281
	United Arab Emirates	99	244	954	2 382
	Australia	147	367	883	2 373
	United Kingdom	1 353	2 836	403	957
	Other countries	2 572	4 971	1 398	3 306
	Total	198 420^r	359 174^r	231 014	406 803
7602.00	Aluminum waste and scrap	123 864^r	168 811^r	127 055	182 609
76.03	Aluminum powders and flakes	2 187^r	8 433^r	2 136	8 809
76.04	Aluminum bars, rods and profiles				
7604.10	Of aluminum, not alloyed				
	United States	8 357^r	30 499^r	12 028	47 237
	Belgium	798	4 274	829	3 912
	Panama	658	1 632	1 215	3 241
	Austria	230	736	692	2 797
	Other countries	735^r	3 439^r	1 067	4 288
	Total	10 778^r	40 580^r	15 831	61 475
7604.21 to 7604.29	Of aluminum alloys				
	United States	26 430^r	129 506^r	30 312	145 862
	China	491	1 614	3 759	12 866
	South Korea	460	1 742	890	3 313
	France	238	1 312	393	2 100
	Germany	131	918^r	244	1 661
	Other countries	686^r	3 856^r	928	5 183
	Total	28 436^r	138 948^r	36 526	170 985
76.05	Aluminum wire	7 704^r	28 089^r	8 093	35 243

TABLE 1a (cont'd)

Item No.		1999		2000^{p}	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	473 122^{r}	1 542 690^{r}	483 424	1 731 679
76.07	Aluminum foil not exceeding 0.2 mm	50 251^{r}	227 575^{r}	43 874	217 436
76.08	Aluminum tubes and pipes	10 778^{r}	52 907^{r}	12 660	62 071
76.09	Aluminum tube or pipe fittings	. .	38 361^{r}	. .	53 872
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	87 558^{r}	. .	96 592
		(number 000)		**(number 000)**	
76.11	Aluminum reservoirs, tanks, vats and similar containers, for any material	8	32 143	4	34 891
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material	863 268^{r}	159 943^{r}	815 905	165 959
76.13	Aluminum containers for compressed or liquefied gas	106	12 602^{r}	98	15 230
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	299^{r}	1 196^{r}	183	777
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	88 659^{r}	. .	93 768
76.16	Other articles of aluminum	. .	253 967^{r}	. .	268 492
EXPORTS					
2606.00	Aluminum ores and concentrates				
	Switzerland	–	–	141	60
	United States	–^{r}	–^{r}	100	15
	Greece	–	–	6	5
	Total	–^{r}	–^{r}	247	80
2620.40	Ash and residues containing mainly aluminum	14 381	8 156	17 786	9 603
2818.20	Aluminum oxide (excluding artificial corundum)				
	United States	52 359	42 108	60 991	50 811
	Other countries	72	172	134	455
	Total	52 431	42 280	61 125	51 266
7601.10	Unwrought aluminum, not alloyed				
	United States	589 576^{r}	1 220 225^{r}	556 959	1 315 008
	Netherlands	129 292	259 693	115 289	243 790
	South Korea	17 256	37 779	35 278	87 971
	Mexico	9 821	21 381	28 607	70 225
	Japan	43 160	79 415	32 819	67 061
	France	6 051	12 235	22 260	44 380
	Other countries	9 721	20 549	13 705	32 012
	Total	804 877^{r}	1 651 277^{r}	804 917	1 860 447
7601.20	Unwrought aluminum alloys				
	United States	920 535^{r}	2 112 695^{r}	882 069	2 309 181
	Japan	103 009	212 626	109 563	249 559
	South Korea	21 347	47 810	27 477	72 351
	United Kingdom	3 075	8 072	4 713	13 738
	Netherlands	212	491	3 265	8 301
	Ireland	2 253	5 708	1 932	5 792
	Other countries	6 409	15 547	3 230	9 923
	Total	1 056 840^{r}	2 402 949^{r}	1 032 249	2 668 845

TABLE 1a (cont'd)

Item No.		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7602.00	Aluminum waste and scrap				
	United States	278 028^r	459 696^r	274 064	494 102
	China	4 568^r	5 319^r	8 404	11 893
	Japan	2 152	3 206	4 106	9 208
	Netherlands	1 922	3 994	1 268	3 076
	Hong Kong	1 005	1 141	554	883
	South Korea	4 895	10 441	592	836
	Other countries	1 900	3 075	938	1 628
	Total	294 470^r	486 872^r	289 926	521 626
76.03	Aluminum powders and flakes	1 546^r	3 209^r	1 835	3 318
76.04	Aluminum bars, rods and profiles	83 911^r	370 755^r	81 821	391 031
76.05	Aluminum wire	94 435	240 133	90 031	257 079
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	335 726^r	985 755^r	345 776	1 116 568
76.07	Aluminum foil not exceeding 0.2 mm	39 392^r	179 358^r	41 322	206 429
76.08	Aluminum tubes and pipes	8 162^r	37 924^r	7 483	40 908
76.09	Aluminum tube or pipe fittings	. .	15 301^r	. .	12 503
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	244 853^r	. .	337 134
		(number 000)		**(number 000)**	
7611.00	Aluminum reservoirs, tanks, vats and similar containers, for any material	1^r	1 379^r	18	1 042
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material	684 844^r	110 993^r	589 040	99 263
7613.00	Aluminum containers for compressed or liquefied gas	581	4 093	760	5 793
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	9 708	30 398	9 275	31 013
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	67 374	. .	68 308
76.16	Other articles of aluminum	. .	184 482^r	. .	194 286

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; ^{p} Preliminary; ^{r} Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 1b. ALUMINUM PRODUCTION, INVENTORIES, TRADE, RECYCLING AND USE (BY QUANTITY), 1990-2000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
						(tonnes)					
CANADIAN PRODUCTION OF ALUMINUM											
Production of aluminum	1 567 395	1 821 642	1 971 843	2 308 868	2 254 681	2 171 992	2 283 210	2 327 188	2 374 118	2 389 835	2 373 461
Alloying metals added	16 968	20 138	19 114	19 744	27 591	27 495	29 912	41 324	43 682	48 822	39 965
Total shipments of aluminum (available primary/alloyed primary aluminum)	1 564 485	1 808 038	1 970 041	2 284 554	2 292 055	2 171 389	2 296 367	2 392 842	2 411 393	2 422 351	2 379 806
CANADIAN INVENTORIES OF ALUMINUM											
Change in year-end primary smelter inventories (increase/decrease)	2 835	14 052	4 985	20 311	(16 944)	25 401	(8 383)	(25 369)	(848)	(667)	13 703
Reported year-end inventories of primary alloyed and unalloyed material by Canadian using companies[1]	13 461	13 753	13 221	15 716	18 255	16 986	15 720	16 701	17 630	21 340	. .
Change in year-end user inventories	(5 424)	292	(532)	2 495	2 539	(1 269)	(1 266)	981	929	3 710	. .
Change from previous year in total inventories (increase/decrease)	(2 589)	14 344	4 453	22 806	(14 405)	24 132	(9 649)	(24 388)	81	3 043	. .
Reported year-end inventories of recycled ingot by Canadian companies[2]	4 121	4 670	4 803	6 182	5 930	4 351	5 198	5 315	5 995	5 415	. .
Reported year-end inventories of scrap originating outside plant by Canadian companies[2]	5 905	6 583	5 929	6 442	9 022	5 763	3 958	7 142	8 206	13 833	. .
TRADE IN ALUMINUM											
Imports of unwrought aluminum	84 863	74 128	85 481	109 121	148 459	134 046	140 255	177 018	202 116	248 584	276 292
Domestic exports of unwrought primary/alloy	1 282 076	1 472 607	1 604 964	1 846 451	1 877 046	1 717 153	1 817 543	1 886 036	1 856 094	1 861 715	1 837 168
Imports of semi-fabricated mill products	328 877	299 847	336 721	370 944	427 443	445 054	414 420	469 177	502 369	583 549	602 737
Domestic exports of semi-fabricated mill products	194 866	215 215	244 452	296 624	350 438	384 587	409 617	453 469	497 268	572 882	577 543
CANADIAN RECYCLING OF ALUMINUM[2]											
Direct use of purchased scrap in finished products	18 617	17 768	24 009	24 084	31 469	30 441	44 555	67 447	78 298	80 689	94 326
Metal used in production of recycled aluminum	115 112	101 503	127 818	131 174	145 661	146 987	81 629	128 515	147 847	145 959	157 794
Imports of dross	1 750	1 923	3 379	2 331	3 065	3 183	3 305	1 774	4 520	4 191	4 212
Domestic exports of dross	49 546	25 820	7 103	3 709	3 018	18 859	10 762	13 021	11 403	14 381	17 786
Imports of scrap	52 645	46 433	52 674	53 466	63 309	56 207	67 625	92 600	107 917	123 862	127 054
Domestic exports of scrap	188 382	173 653	197 560	198 954	234 817	237 162	241 475	271 258	281 160	294 468	289 926
Imports of recycled aluminum[3]	. .	. .	. .	. .	. .	. .	. .	5 376	71 094	91 227	140 957
CANADIAN USE OF ALUMINUM											
Canadian apparent use of primary aluminum[4]	364 683	423 903	455 012	570 030	549 063	612 414	609 430	654 060	686 402	721 036	. .
Canadian use of aluminum[5]	637 599	598 569	690 069	752 617	832 260	803 624	758 868	919 764	987 900	1 044 071	. .
Reported Canadian use of aluminum	453 257	446 239	481 089	568 854	635 024	635 402	676 935	764 438	889 973	999 242	. .

Source: Natural Resources Canada.
. . Not available.
[1] Data include use of metal and reported year-end inventories of primary and alloy by companies surveyed by NRCan. The number of respondents changed along the length of the series due to business changes. As of 2000, approximately 160 companies were surveyed. [2] HS Code 76.01 "Unwrought aluminum" includes 7601.20.00.21 "Remelt Scrap Ingot." It also includes grain, slabs, wire bar and granules cut from ingots (for use in cleaning compounds), blocks and notched bars. [3] HS Code 7601.20.00.21 Imports of recycled aluminum - Unwrought Ingots: "Remelt scrap ingots" became active in 1998. (In 1997, the active code was 7601.20.10.21; from 1990 to the end of 1996, the active code was 7601.20.10.93, but also included data next reported under 7601.20.10.29 and now reported under 7601.20.00.29; from 1988 to 1990, the active code was 7601.20.10.40.) [4] Canadian Apparent Use of Primary Aluminum = Shipments of aluminum less exports (HS Code 76.0.1) plus imports (HS Code 76.01) less imports of "Remelt Scrap Ingot" (HS Code 7601.20.00.21) plus year-end inventory change. (Note: Earlier years' data for trade in recycled aluminum are not available or included.) [5] Canadian Use of Aluminum = Shipments of aluminum plus imports (HS Code 76.01), less exports (HS Code 76.01) plus imports semi-fabricated (HS Code 76.02) less exports (HS Code 76.02) plus use of scrap in finished products plus use of aluminum in recycled ingot plus inventory change (primary and recycled).

TABLE 2. CANADA, ALUMINUM SMELTER CAPACITY

Company	As of December 31, 2000
	(tonnes/year)
Alcan Aluminium Limited	
Quebec	
Grande-Baie	186 000
Arvida, Jonquière	238 000
Isle-Maligne	–[a]
Alma	400 000[b]
Shawinigan	88 000
Beauharnois	49 000
Laterrière	210 000
British Columbia	
Kitimat	272 000
Total Alcan capacity	1 443 000
Canadian Reynolds Metals Company, Limited (Alcoa)	
Quebec	
Baie-Comeau	418 000
Aluminerie de Bécancour Inc.	
Quebec	
Bécancour	390 000
Aluminerie Alouette Inc.	
Quebec	
Sept-Îles	244 000
Alcoa Aluminerie Lauralco Inc.	
Quebec	
Deschambault	240 000
Total Canadian capacity	2 735 000

Source: Natural Resources Canada.
– Nil.
[a] The last potline closed in March 2000. [b] Will reach full capacity in mid-2001.

TABLE 3a. USE[1] OF ALUMINUM METAL[4] IN CANADA AT FIRST PROCESSING STAGE, 1997-99

	1997[r,a]	1998[r,a]	1999[r,a,5]
		(tonnes)	
METAL USED IN CASTINGS[6]			
Permanent mould	104 691	128 966	129 574
Sand	3 351	3 262	4 442
Die and other	152 244	166 763	205 781
Total	260 286	298 991	339 797
METAL USED IN WROUGHT PRODUCTS			
Sheet, plate, coil and foil	181 005	208 563	229 139
Extrusions, including tubing	149 958	188 610	234 843
Other wrought products (including rods, forgings and slugs)	134 132	149 451	153 936
Total	465 095	546 624	617 918
METAL USED IN OTHER PRODUCTS			
Destructive uses (deoxidizer), non-aluminum base alloys, powder and paste and other uses	39 057	44 358	41 526
Total used	764 438	889 973	999 242
Aluminum metal used for the production of recycled aluminum[2]	128 515	147 847	145 959

	Metal Entering Plant			On Hand at December 31		
	1997	1998	1999	1997	1998	1999
Primary aluminum and alloys	572 217	663 468	733 569	16 701	17 630	21 340
Recycled aluminum	138 771	159 234	198 370	5 315	5 995	5 415
Scrap originating outside plant	213 482	248 068	253 985	7 142	8 206	13 833
Total	924 471	1 070 770	1 185 925	29 159	31 831	40 588
Aluminum shipments[3]				32 604	31 001	33 674

Source: Natural Resources Canada.

[r] Revised.

[a] Increase in number of companies being surveyed; therefore, the closing inventory of the previous year does not equal the opening inventory of the current year.

[1] Available data as reported by users. [2] Aluminum metal used in the production of recycled aluminum is not included in usage totals. [3] Aluminum metal shipped without change. Does not refer to shipments of goods of own manufacture. [4] Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap. [5] For 1999 this table is compiled from Natural Resources Canada's annual survey, "Consumption of Aluminum Metal" from data for 169 Canadian users. [6] Metal reported used in casting may contain runaround scrap. Work is under way to revise the questionnaire for 2001.

Note: Numbers may not add to totals due to rounding.

TABLE 3b. USE[1] OF ALUMINUM METAL[2] IN CANADA, BY TYPE AT FIRST PROCESSING STAGE, 1988-99

	1988[a]	1989[a]	1990[a]	1991[a]	1992[a]	1993[a]	1994[a]	1995	1996[a]	1997[r,a]	1998[r,a]	1999[r,a,4]
							(tonnes)					
Type of aluminum metal used in products other than recycled aluminum												
Primary aluminum and alloys	381 106	393 027	351 877	355 010	369 185	447 997	485 845	490 000	512 865	558 139	653 320	719 124
Purchased recycled aluminum	70 633	75 031	82 763	73 461	87 896	95 774	117 710	114 961	119 515	138 852	158 355	199 429
Outside aluminum scrap	28 039	27 306	18 617	17 768	24 009	25 084	31 469	30 441	44 555	67 447	78 298	80 689
Total used in products other than in recycled aluminum	479 779	495 363	453 257	446 239	481 089	568 854	635 024	635 402	676 935	764 438	889 973	999 242
Type of aluminum metal used in recycled aluminum[3]												
Primary aluminum and alloys	13 307	22 383	x	x	x	x	x	x	x	14 650	x	10 879
Outside aluminum scrap	94 308	79 716	x	x	x	x	x	x	x	113 865	x	135 081
Total used in recycled aluminum[3]	107 615	102 098	115 112	101 503	127 818	131 174	145 661	146 987	81 629	128 515	147 847	145 959

Source: Natural Resources Canada.

[r] Revised; x confidential.

[a] Increase in number of companies being surveyed.

[1] Available data as reported by users. [2] Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap.

[3] Aluminum metal used in recycled aluminum is not included in "Total used in products other than in recycled aluminum" above.

[4] For 1999 this table is compiled from Natural Resources Canada's annual survey, "Consumption of Aluminum Metal" from data for 169 Canadian users.

Note: Numbers may not add to totals due to rounding.

TABLE 4. AVERAGE ALUMINUM PRICES

Year	Month	LME Cash Settlement[1]	*Metals Week* U.S. Markets[1]
		(US$/t)	(US¢/lb)
ANNUAL AVERAGES[2]			
1987		1 560.90	72.3
1988		2 597.80	110.1
1989		1 951.50	87.8
1990		1 751.80	75.0
1991		1 302.70	59.5
1992		1 254.60	57.5
1993		1 139.40	53.3
1994		1 477.20	71.2
1995		1 806.10	85.9
1996		1 506.00	71.3
1997		1 599.70	77.1
1998		1 357.80	65.6
1999		1 361.09	65.7
2000		1 549.14	74.6
MONTHLY AVERAGES			
1999	January	1 218.80	58.8
	February	1 187.25	57.6
	March	1 181.96	58.7
	April	1 278.55	62.4
	May	1 323.79	64.5
	June	1 315.64	63.1
	July	1 404.16	67.5
	August	1 431.69	68.6
	September	1 492.86	71.3
	October	1 474.79	70.8
	November	1 473.09	70.6
	December	1 554.80	74.7
2000	January	1 680.70	80.1
	February	1 670.67	80.3
	March	1 577.41	76.2
	April	1 457.61	70.6
	May	1 467.19	70.9
	June	1 506.73	72.7
	July	1 563.88	76.3
	August	1 528.02	74.4
	September	1 601.60	77.2
	October	1 500.66	72.3
	November	1 474.23	70.1
	December	1 565.87	74.3

Sources: Natural Resources Canada; *Metals Week*.

[1] Highest grade sold. [2] Primary ingots, minimum 99.7% purity; prior to October 1988, minimum 99.5% purity.

TABLE 5. AVERAGE ALUMINUM ALLOY (RECYCLED) PRICES

Year	Month	LME Alloy[1] Cash Settlement
		(US$/t)
ANNUAL AVERAGES		
1993		1 005.2
1994		1 452.9
1995		1 656.0
1996		1 302.8
1997		1 461.0
1998		1 203.8
1999		1 191.2
2000		1 216.9
MONTHLY AVERAGES		
1999	January	1 024.3
	February	1 022.7
	March	1 058.5
	April	1 161.4
	May	1 232.3
	June	1 200.8
	July	1 239.0
	August	1 240.2
	September	1 287.8
	October	1 266.3
	November	1 257.7
	December	1 303.4
2000	January	1 387.4
	February	1 345.8
	March	1 273.9
	April	1 171.4
	May	1 181.3
	June	1 190.7
	July	1 223.5
	August	1 176.7
	September	1 212.4
	October	1 143.6
	November	1 128.5
	December	1 167.5

Sources: Natural Resources Canada; *Metals Week.*

[1] Alloy ingots meeting LME specifications.

TABLE 6. WORLD MINE PRODUCTION OF BAUXITE, 1996-2000

	World Rank in 2000	1996	1997	1998	1999	2000●
				(000 tonnes)		
Australia	1	43 063.0	44 465.0	44 553.0	48 493.0	51 200.0
Guinea	2	18 282.0^r	19 250.0	17 000.0	17 200.0	17 500.0
Brazil	3	11 060.1	11 162.8^r	11 961.1^r	13 838.8	13 850.0
Jamaica	4	11 828.6	11 987.3	12 646.4	11 688.5	11 300.0
China	5	8 878.8	9 000.0	9 000.0	9 500.0	9 500.0
India	6	5757.5	5 800.3	5 980.1	6 712.2	7 800.0
Venezuela	7	4 806.9	5 083.9	4 825.6	4 471.6	4 950.0
Russia	8	3 928.0	3 991.0	3 488.4	3 500.0	3 900.0
Kazakhstan	9	3 345.9^r	3 416.0	3 436.8	3 606.5	3 700.0
Suriname	10	3 695.3	3 877.2	3 889.6	3 714.6	3 300.0
Guyana	11	2 475.5	2 470.9	2 267.4	2 359.3	2 600.0
Greece	12	2 451.7^r	1 876.6^r	1 823.0	1 882.5	1 950.0
Indonesia	13	842.0	808.7	1 055.6	1 116.3	1 120.0
Hungary	14	1 055.8	742.6	908.9^r	935.2	1 050.0
Serbia and Montenegro	15	323.0	470.0	226.0^r	500.0	500.0
Ghana	16	473.2	519.2	442.5	353.3	380.0
Turkey	17	544.5	369.5	458.0	207.7	210.0
Malaysia	18	218.7	279.1^r	160.3	222.7	150.0
Iran●	19	100.0	100.0	100.0	100.0	100.0
United States	20	100.0	100.0	100.0	100.0	100.0
France	21	165.0	164.0	80.0	70.0	70.0
Pakistan	22	4.1	4.9	5.0	35.7	35.0
Vietnam	23	30.0	30.0	30.0	30.0	30.0
Mozambique	24	11.5	8.2	6.1	7.9	8.0
Romania	25	175.2	127.5	161.9^r	–	–
Total world		123 616.3^r	126 104.7^r	124 605.7^r	130 645.6	135 273.0
% change from previous year		4.5	2.0	−1.2	4.8	3.5

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
● Estimated; ^{r} Revised.

TABLE 7. WORLD PRODUCTION OF ALUMINA (HYDRATE), 1995-2000

	World Rank in 2000	1995	1996	1997	1998	1999	2000●
					(000 tonnes)		
Australia	1	13 147.0	13 349.0	13 385.0	13 853.0	14 378.0	15 200.0
United States[3]	2	4 533.0	4 700.0	5 093.0	5 592.0	4 928.0	5 100.0
China	3	2 222.7	2 490.0^r	2 922.8	3 327.4	3 823.0	4 290.0
Brazil	4	2 142.9	2 759.0	3 088.0	3 222.1^r	3 515.1	4 200.0
Jamaica	5	3 030.2	3 199.5	3 394.2	3 440.2	3 569.6	3 640.0
Russia	6	2 254.3	2 148.0	2 379.8	2 465.4	2 657.1	2 850.0
India	7	1 672.0	1 706.0	1 940.0^r	1 855.0^r	1 930.0	1 950.0
Suriname	8	1 588.8	1 642.9	1 725.9	1771.9^r	1 853.1	1 850.0
Venezuela	9	1 742.0	1 775.0	1 730.4	1 553.4	1 476.6	1 500.0
Ireland[1]	10	1 185.6	1 233.5	1 272.8	1 323.0	1 350.0	1 350.0
Ukraine	11	1 198.0	1 159.5^r	1 074.5	1 290.7	1 230.2	1 300.0
Canada[2]	12	1 064.0	1 060.0	1 165.0	1 229.0	1 233.0	1 240.0
Kazakhstan	13	1 022.0	1 083.4	1 094.2	1 084.5^r	1 157.7	1 210.0
Spain	14	1 094.8	1 094.8	1 110.3	1 110.0^r	1 112.0	1 110.0
Italy	15	857.0	881.0	914.0	935.0^r	973.0	975.0
Germany	16	994.0	792.0	850.0	778.3	800.0	800.0
Japan	17	743.2	718.9	728.0	737.6	736.6	740.0
Greece	18	629.7	619.8	615.7	649.4	633.0	640.0
Guinea	19	630.4	622.0	527.0	600.0^r	569.0	600.0
France	20	525.0	542.0	589.0	520.0	556.0	560.0
Romania[1]	21	322.8	258.5	279.5	250.3^r	277.4	280.0
Hungary	22	353.5	358.7	350.0^r	160.0^r	200.0	200.0
Turkey	23	172.0	159.3	164.3	156.8	159.1	160.0
Serbia and Montenegro	24	35.3	105.0	159.5^r	152.6^r	156.0	160.0
United Kingdom	25	108.0	99.0	100.0	96.0	115.0	115.0
Azerbaijan	–	26.1	–	–	–	–	–
Slovakia	–	65.0	56.0	46.8	–	–	–
South Korea	–	–	100.0	70.0	–	–	–
Total world		43 359.3	44 712.8^r	46 769.7^r	48 253.6^r	49 388.5	52 020.0
% change from previous year		3.8	3.1	4.6	3.2	2.4	5.3

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics; International International Aluminium Association; media reports.
– Nil; ● Estimated; ^{r} Revised.

[1] Calcined. [2] Alumina equivalent. [3] Calcined equivalent.

TABLE 8. WORLD PRODUCTION OF ALUMINUM, 1995-2001

	World Rank in 2000	1995	1996	1997	1998	1999	2000[•]	2001[f]
					(000 tonnes)			
United States	1	3 375.1	3 577.2	3 603.4	3 712.7	3 778.6	3 668.0	3 000.0
Russia	2	2 789.8[r]	2 871.6[r]	2 906.0	3 004.7	3 146.4	3 250.0	3 400.0
China	3	1 676.1	1 770.9	2 035.0	2 335.7[r]	2 598.5	2 830.0	3 150.0
Canada	4	2 172.0	2 283.2	2 327.2	2 374.1	2 389.8	2 373.0	2 600.0
Australia	5	1 292.6	1 370.3	1 490.1	1 626.2	1 719.3	1 770.0	1 800.0
Brazil	6	1 188.1	1 197.4	1 189.1	1 208.0	1 249.6	1 280.0	1 285.0
Norway	7	846.7	862.3	918.6	994.2	1 009.0	1 020.0	1 040.0
South Africa	8	233.3	617.0	682.9	692.5	686.9	700.0	725.0
India	9	536.5	530.6	544.9	542.8[r]	600.2	650.0	650.0
Germany	10	575.2	576.5	571.9	612.4	633.8	640.0	640.0
Venezuela	11	627.9	634.9	640.8	586.5	571.0	575.0	575.0
Bahrain	12	453.9	464.5	489.9	501.3	502.6	510.0	510.0
Dubai	13	247.4	258.5	377.7	386.6	441.0	510.0	540.0
France	14	364.5	380.1	399.4	423.6	455.1	435.0	455.0
Spain	15	361.9	361.8	359.9	360.4	363.9	365.0	365.0
New Zealand	16	273.3	284.5	310.3	317.4	326.7	330.0	330.0
United Kingdom	17	237.9	240.0	247.7	258.4	269.7	300.0	320.0
Netherlands	18	215.6	227.0	231.8	263.7	287.4	290.0	300.0
Tadjikistan	19	237.0	198.3	188.9	195.6	229.1	270.0	280.0
Argentina	20	185.5	183.9	187.2[r]	186.7	206.4	265.0	265.0
Iceland	21	100.2	103.4	122.9	173.4	221.5	225.0	250.0
Egypt	22	180.3	179.2	178.2	187.2	186.7	190.0	190.0
Italy	23	177.8	184.4	187.7	187.0	186.5	190.0	190.0
Romania	24	140.5	140.9	161.9	174.0	174.4	175.0	180.0
Ghana	25	135.4	137.0	151.6	56.1	114.0	160.0	160.0
Greece	26	130.9	130.9	132.6	146.1	159.9	160.0	165.0
Iran	27	117.0	80.1	92.3	119.0[r]	130.0	135.0	135.0
Indonesia	28	228.1	223.1	219.4[r]	133.4	111.7	130.0	130.0
Ukraine	29	95.1	89.9	100.5	106.7	112.4	115.0	115.0
Slovakia	30	59.0	111.5	110.2	108.0	109.2	110.0	110.0
Bosnia	31	–	–	8.0	30.0	70.0	100.0	120.0
Sweden	32	94.5	98.3	98.4	95.7	98.5	100.0	100.0
Cameroon	33	79.3	82.3	90.9	81.6	91.9	95.0	95.0
Slovenia	34	70.2	65.8	74.4	70.8	77.2	80.0	117.0
Serbia and Montenegro	35	17.0[r]	37.4[r]	65.7[r]	60.1[r]	72.5	80.0	85.0
Mexico	36	10.4	61.5	66.4	61.8	62.7	63.0	63.0
Turkey	37	61.5	62.1	62.0	61.8	61.7	62.0	62.0
Mozambique	38	–	–	–	–	–	60.0	220.0
Poland	39	50.8	51.5	51.5	51.5	46.7	45.0	45.0
Switzerland	40	20.7	26.6	27.3	32.1	34.4	35.0	40.0
Hungary	41	34.9	33.5	32.5	33.7	33.6	34.0	34.0
Japan	42	18.0	17.0	16.7	16.3	10.9	10.0	10.0
Nigeria	43	–	–	2.5	25.5	15.9	10.0	–
Suriname	44	28.1	26.0	23.1	27.1	6.6	–	–
Azerbaijan	–	11.0	–	–	–	–	–	–
Total world		19 751.0[r]	20 832.9[r]	21 779.4[r]	22 622.4[r]	23 654.1	24 405.0	24 846.0
% change from previous year		3.3	5.5	4.5	3.9	4.6	3.2	1.8

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics; International Primary Aluminium Institute.

– Nil; • Estimated; [f] Forecast; [r] Revised.

TABLE 9. PRIMARY ALUMINUM, QUANTITY USED BY COUNTRY, 1995-99

	World Rank in 1999	1995	1996	1997	1998	1999
				(000 tonnes)		
United States	1	5 300.0	5 500.0	5 800.0	6 100.0	6 500.0
China	2	1 942.0^{r}	2 142.5^{r}	2 290.0^{r}	2 421.0^{r}	2 972.9
Japan	3	2 336.4	2 392.6	2 434.3	2 079.9	2 099.7
Germany	4	1 510.0	1 355.0	1 558.0^{r}	1 519.0^{r}	1 520.0
Canada	5	611.9	619.9	628.2	734.1^{r}	860.2
South Korea	6	675.3	674.3	666.3	505.7	813.9
France	7	743.8	671.7	724.2^{r}	733.8^{r}	785.9
Italy	8	631.0	614.0	671.0	674.0^{r}	722.0
United Kingdom	9	576.0^{r}	571.0^{r}	583.0^{r}	579.0^{r}	581.0
India	10	581.0	584.8	544.5	566.0^{r}	570.0
Russia	11	692.2^{r}	444.7^{r}	469.7^{r}	489.2	556.1
Spain	12	350.0	360.0	430.0	435.5^{r}	494.0
Taiwan	13	362.5	310.3	374.3	300.7	464.1
Brazil	14	499.8	497.0	478.6	521.4	463.1
Australia	15	343.0	321.8	352.0	367.1^{r}	358.6
Belgium-Luxembourg	16	340.0	331.0	345.0	370.0^{r}	350.0
Norway	17	157.0	169.0	197.0	155.0^{r}	220.2
Greece	18	162.8	156.4	203.8	212.7^{r}	212.5
Turkey	19	144.0	136.0	164.8	180.7	169.4
Hungary	20	120.6	158.6	183.4	164.8^{r}	165.0
Austria	21	150.0	155.0	162.0	163.0^{r}	165.0
Netherlands	22	150.0	155.0^{r}	162.0^{r}	163.0^{r}	165.0
Switzerland	23	147.0^{r}	140.2	144.0^{r}	164.9	157.0
Thailand	24	235.5	220.2	232.8	129.0	155.3
Bahrain	25	135.0	137.0	137.0	140.0	142.0
Indonesia	26	147.7	161.3	203.0^{r}	75.4	138.7
Sweden	27	116.0	129.0	142.0	177.0	132.2
South Africa	28	119.7	101.0^{r}	124.4^{r}	142.8	125.0
Venezuela	29	183.0	206.9	193.4	179.7	121.8
Romania	30	46.4^{r}	35.7^{r}	62.7^{r}	787.7^{r}	113.5
Iran	31	119.0^{r}	106.0^{r}	104.9^{r}	111.1^{r}	110.0
Malaysia	32	114.0	115.0	148.0	90.0	99.8
Poland	33	79.2	73.2	83.3	86.1^{r}	95.4
Argentina	34	84.0	86.4	95.3	104.7^{r}	92.3
Mexico	35	40.0	92.7	83.2	91.9	87.5
Egypt	36	77.4	79.2	97.9	91.6	82.7
Portugal	37	66.7	58.1	75.4	68.3	82.0
Slovenia	38	56.9	46.5	52.8^{r}	74.6^{r}	75.3
Czech Republic	39	58.9	53.0	62.8	78.9^{r}	65.7
Ukraine	40	50.1	51.0	60.0	60.3	60.0
Israel	41	39.8	37.2	39.5	45.9	43.9
New Zealand	42	38.6	38.9	37.0	34.2	42.8
Denmark	43	27.6	27.0	36.0	38.9	39.4
Finland	44	31.0	30.4	33.1	33.0	37.1
Other Asia	45	35.0	35.0	35.0	35.0	35.0
Philippines	46	31.4	26.3	34.2	24.0	33.6
Singapore	47	39.2	40.0	15.0	33.5	33.5
Colombia	48	33.3	35.3^{r}	42.8^{r}	36.3^{r}	27.4
Slovakia	49	25.0	25.0	25.2	22.2	25.2
Saudi Arabia	50	30.0	25.0	25.0	25.0	25.0
Vietnam	51	13.9	15.0	15.0	12.6	25.0
Croatia	52	24.4	20.7	22.0	24.0	24.0
North Korea^{e}	53	20.0	20.0	20.0	20.0	22.0
Cameroon	54	21.0	18.0	24.7	24.9	22.0
Dubai	55	24.6	19.4	32.1	26.0	20.0
Lebanon	56	7.0	10.0	17.0	17.0	17.0
Ghana	57	16.1	16.1	16.0	16.0	16.0
Chile	58	15.0	13.9	15.5	25.3	15.0
Serbia and Montenegro	59	9.0	17.3	23.7^{r}	19.2^{r}	13.1
Other Africa	60	4.7	9.9	12.0	10.0	12.0
Bangladesh	61	10.0	10.0	10.0	10.0	10.0
Other Americas	62	10.0	12.0	10.0	10.0	10.0
Pakistan	63	13.0	15.0	15.0	15.0	9.4
Belarus	64	–	–	7.4	9.1	9.0
Ireland	65	3.3	3.8	5.8	6.6^{r}	8.2

TABLE 9 (cont'd)

	World Rank in 1999	1995	1996	1997	1998	1999
				(000 tonnes)		
Bulgaria	66	6.0	6.7	7.8	8.0	8.0
Nigeria	67	7.0	7.0	7.0	7.0	7.0
Algeria	68	5.0	5.0	5.0	5.0	5.0
Tunisia	69	3.3	3.5	1.0	3.8	4.0
Morocco	70	2.0	1.6	2.0	3.4	3.1
Macedonia	71	2.0	2.8	2.0	3.0	3.0
Iceland	72	1.0	1.0	1.7	3.0	3.0
Other Europe	73	–	–	2.0	1.5	2.0
Kazakstan	74	–	–	1.6	1.7	2.0
Cuba	75	1.0	1.0	1.0	1.0	1.0
Albania[e]	76	1.0	1.0	1.0	1.0	1.0
Iraq[e]	77	1.0	1.0	1.0	1.0	1.0
Peru	78	4.5	3.6	2.5	2.5	0.9
Hong Kong[1]		40.0	40.0	n.a.	n.a.	n.a.
Total world		20 870.5[r]	20 807.9[r]	22 129.6[r]	22 005.2[r]	23 761.4
% change from previous year		3.8	–0.3	6.4	–0.6	8.0

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metals Statistics; International Primary Aluminium Institute.

– Nil; [e] Estimated; n.a. Note applicable; [r] Revised.

[1] Starting in 1997, Hong Kong is included with China.

Cement

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Shipments of cement in 2000 were estimated to be 12.61 Mt valued at $1.26 billion, based on preliminary data. This compares to shipments of 12.63 Mt valued at $1.23 billion in 1999, based on final data (Table 1). Demand for cement in most regions remained firm, largely based on an increase of about 10% in gross expenditures on construction, which included a moderate increase in housing starts.

CANADIAN INDUSTRY

The Canadian cement industry is diversified and primarily integrated with the construction aggregates and concrete products sectors. Information on the aggregates sector is included in a separate chapter entitled "Mineral Aggregates."

The clinker-producing and finish-grinding capacities of cement plants are listed in Table 2. The reported kiln capacity in 1999 was about 14.8 Mt with about 14.3 Mt active, according to the most recent figures available. Clinker production is more indicative of ultimate cement production capacity because clinker can be stockpiled for later use or sale. The overall output of the cement industry is best represented by total cement shipments plus clinker exports, as shown in Table 3. The average kiln capacity has increased from about 300 000 t/y in 1980 to about 550 000 t/y in 1999; the average kiln age based on clinker capacity is reported to be about 20 years, according to the Portland Cement Association.

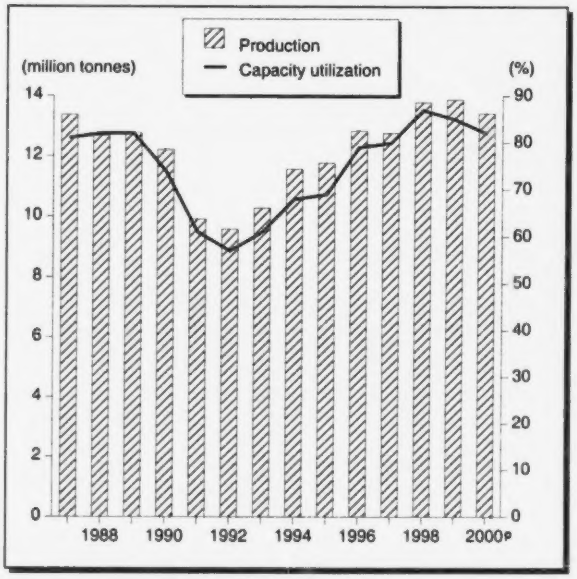
Newfoundland Cement Company Limited closed the North Star Cement Limited plant in Corner Brook, Newfoundland, in August 2000. The plant and distribution facilities were sold to St. Lawrence Cement (SLC), based in Montreal. It is expected that the plant will be dismantled. A Lafarge Canada Inc. (Lafarge) plant in Nova Scotia is now the only cement producer in Atlantic Canada.

In Quebec, three clinker-producing plants account for about 18% of Canada's output. SLC, Lafarge and Ciment Québec Inc. are the only producers of clinker and cement in this region. These three companies share markets about equally.

In Ontario, clinker-producing plants account for nearly 50% of Canadian capacity. Blue Circle Canada Inc., SLC and Lafarge are the largest producers. (SLC continued with a permitting process to build a new 2-Mt/y cement plant near Greenport, New York.)

In western Canada, this region's clinker-producing capacity accounts for about 30% of Canada's total clinker capacity. Changes in plant capacities are highlighted in Table 2, and relatively recent developments in this region are described in the "Cement" chapter of the 1998 *Canadian Minerals Yearbook*.

Figure 1
Canadian Cement Production, 1987-2000



Sources: Statistics Canada; Portland Cement Association.
pPreliminary.
Note: Cement production includes clinker exports.

Lafarge completed a $400 million merger with The Warren Paving and Materials Group Ltd., Canada's largest privately held supplier of construction aggregate (crushed stone, and sand and gravel) and a leading supplier of asphalt and paving services with sales of about $600 million in 2000. As part of an agreement reached with the Competition Bureau of Canada, Lafarge will divest certain assets in Alberta and the Fraser Valley of British Columbia.

WORLD DEVELOPMENTS

Multinational companies with widespread production and distribution networks continued to become more dominant in world cement markets.

The European Commission authorized, in March 2000, the acquisition of Blue Circle Industries plc, of England, by Lafarge SA, of France. Authorizations followed in Canada in April, contingent upon certain follow-up divestment in Canada, as mentioned, and then in the United States in June, again contingent on certain divestment.

World cement production in 1999 was 1600 Mt, according to estimates by the U.S. Geological Survey (USGS). China is the world's largest producer (573 Mt) followed by India (90 Mt), the United States (88 Mt) and Japan (80 Mt).

U.S. antidumping duties against grey Portland cement and clinker from Japan and Mexico remained in effect in 2000.

USE AND TRADE

Cross-border trade of both cement and clinker with the United States varies considerably from year to year depending on construction activity. Annual exports of cement to the United States amount to 3-4 Mt and account for about one third of total Canadian production (shipments), as defined in Table 1. Exports are mainly destined for the southern Great Lakes region and the northwestern Pacific region. Similarly, Canada's imports of cement amount to about 0.5 Mt and relate mainly to the equivalent cross-border regions.

Low-cost marine transportation has influenced world trade considerably. Total U.S. imports of cement (excluding clinker) for use were about 24 Mt in 2000, or 21% of apparent use. Asian sources (China, Korea and Thailand) have been major suppliers since 1998, according to the USGS.

The importance of supplementary cementing materials (SCMs) for a range of uses is increasingly being recognized. For example, about 1.1 Mt of fly ash, accounting for about 20% of production, were used in 2000, according to a recent NRCan-coordinated survey in cooperation with the Canadian Electricity Association (Table 4). International trade is also important for these products, particularly for fly ash used in blended cements and as a partial replacement for Portland cement in concrete products. In either case, these uses result in relatively lower unit monetary costs and in lower environmental costs associated with the relevant final products.

TECHNOLOGY

Energy conservation programs by the Canadian cement industry have reduced the energy consumption per unit of production by about 26% since 1974. Although the number of kilns has decreased, their individual capacities have increased and the more efficient dry-process plants now account for more than 95% of total clinker capacity. The fuel mix has changed considerably away from natural gas and petroleum products toward coal and/or coke. In 1999, of 17 clinker-producing plants, 11 reported using coal and/or coke as their primary fuel. Eight plants reported using waste as an alternative or supplemental fuel, according to the Canadian Portland Cement Association (CPCA). Waste was used at one plant as a primary fuel. In 1999, the Canadian cement industry consumed, on average, 4507 megajoules per tonne of production. The types of fuel consumed, including waste fuels, are highlighted in Table 2.

Suitable waste materials are an attractive alternative fuel because pyro-processing accounts for more than 80% of total energy needs, or 30-40% of total production costs. In the context of sustainable development of non-renewable fossil fuels, it is apparent that improved waste management involving combustion technology is leading to greater conservation.

Natural Resources Canada (NRCan) continued to seek ideas, advice and financial support for the new International Centre for Sustainable Development of Cement and Concrete (ICON). Although this centre draws on some current initiatives and the expertise of the Canada Centre for Mineral and Energy Technology (CANMET), it is dependent upon new partnerships with industry, academic institutions and other governments for strengthening global efforts relevant to the sustainable development of cement and concrete. Considering advanced concrete programs that contribute to infrastructure durability, waste reduction and energy saving, a demonstration project involving roller compacted concrete (RCC), which includes high volumes of fly ash (50% or more), was placed at two sites in the Edmonton area in August 2000.

The use of high-volume, fly-ash concrete is growing; for example, the Greater Vancouver Regional District has established a new web site for EcoSmart™ concrete (high-volume, fly-ash concrete) in order to provide a forum for information about the benefits, costs and challenges associated with this type of concrete. The EcoSmart Concrete Project also involves studying promising new techniques in intergrinding (blended cement) and precast (pre-manufactured) concrete. Some of these technical initiatives involve collaboration with CANMET and the Electric Power Research Institute (EPRI) of Palo Alto, California.

In June 2000, the Committee for the Organization of CANMET/ACI Conferences, the National Research Council's Institute for Research in Construction, and others sponsored the Fifth CANMET/ACI International Conference on Durability of Concrete, in Barcelona, Spain, as well as the Sixth CANMET/ACI International Conference on Superplasticizers and Other Chemical Admixtures in Concrete, in October, in Nice, France. In 2001 this committee will sponsor three international conferences: the Seventh CANMET/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, to be held July 22-27, 2001, in Madras, India; the Fifth CANMET/ACI/ International Conference on Recent Advances in Concrete Technology, July 29-August 1, 2001, in Singapore; and the Three-Day International Symposium on Sustainable Development and Concrete Technology, September 16-19, 2001, in San Francisco.

Research efforts to develop new superplasticizers for use in conjunction with SCMs for high-performance concrete have increased in recent years. As a result of this, a publication entitled *Superplasticizers: Properties and Applications in Concrete*, by Ramachandran, Malhotra, Jolicoeur and Spiratos, was compiled to integrate the chemistry and applications concerned. This publication, which includes 14 chapters and more than 400 pages, can be obtained from the Materials Technology Laboratory (MTL) of NRCan's CANMET by contacting Alan Bowles by telephone at (613) 995-8814 or by e-mail at abowles@nrcan.gc.ca.

NRCan, mainly in collaboration with the Canadian Industry Program for Energy Conservation (CIPEC), continued to develop long-term strategies related to major energy-consuming sectors, including cement and lime.

OUTLOOK

Cement shipments in 2001 are expected to be marginally higher based mainly on relatively low interest rates and an increase of about 4% in the value of construction to nearly $125 billion, according to the Canadian Construction Association. Also, the Infrastructure Canada Program, involving federal, provincial, territorial and municipal governments, will contribute about $6 billion across Canada during the six years until 2005/06, much of this related to engineering infrastructure.

Housing starts were about 152 000 in 2000, according to the Canada Mortgage and Housing Corporation. By way of comparison, housing starts were 137 000 in 1998 and 150 000 in 1999. With real economic growth in both Canada and the United States forecast to continue, the outlook remains positive for the office and industrial building sectors. (Additional information relating to residential construction can be obtained on the Internet at http://www.cmhc-schl.gc.ca/cmhc.html.)

Energy management in the cement industry will continue to concentrate on gains in efficiency based on timely switching among the available choices of common fuels. However, most longer-term cost savings are expected to result from the partial substitution of fossil fuels by waste-derived fuels. For example, in selected regions, in the case of Refuse Derived Fuel (RDF), about 70% (by volume) of municipal solid waste from post-recycled curbside garbage could be extracted for use by the cement industry. This would reduce by about two thirds the volume of material for disposal as landfill. Under certain circumstances using RDF, reductions in requirements for traditional fuels have been predicted to be as high as 20-25%.

World production and use of cement in 2000 was 1.7 billion t, according to the USGS. These amounts are forecast to be about 1.9 billion t and 2.1 billion t in 2005 and 2010, respectively, according to a report by Ocean Shipping Consultants Ltd. Of the overall forecast 500-Mt increase, accepting the 1999 base-year amount of 1.6 billion t by the USGS, Asia is expected to account for more than 60%, Africa and the Middle East for 13%, and Central and South America for about 10%.

The use of supplementary cementing materials incorporating fly ash, silica fume or other pozzolanic materials such as ground blast furnace slags, as a partial substitute for Portland cement, is expected to become more important in modern cement and concrete practices.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of February 1, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
25.23	Portland cement, aluminous cement, slag cement, supersulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinkers				
2523.10	Cement clinkers	Free	Free	Free	Free
	Portland cement:				
2523.21	White cement, whether or not artificially coloured	Free	Free	Free	Free
2523.29	Other	Free	Free	Free	Free
2523.30	Aluminous cement	Free	Free	Free	Free
2523.90	Other hydraulic cements	Free	Free	Free	Free
68.10	Articles of cement, of concrete or of artificial stone, whether or not reinforced				
	Tiles, flagstones, bricks and similar articles:				
6810.11	Building blocks and bricks	3%	Free	Free	Free
6810.19	Other	5%	Free	Free	Free
6810.91	Prefabricated structural components for building or civil engineering	5%	Free	Free	Free
6810.99	Other				
6810.99.10	Pipes	5%	Free	Free	Free
6810.99.90	Other	5%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, CEMENT PRODUCTION AND TRADE, 1998-2000

Item No.		1998		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION[1] (all forms)							
	Newfoundland	x	x	x	x	x	x
	Nova Scotia	x	x	x	x	x	x
	Quebec	2 700 103	221 344	2 842 667	237 306	2 830 381	240 549
	Ontario	5 190 592	460 179	5 548 561	511 200	5 344 406	507 182
	Alberta	x	x	x	x	x	x
	British Columbia	1 728 277	172 015	1 643 184	168 090	1 919 187	201 443
	Total	12 124 058	1 147 757	12 634 440	1 232 151	12 611 954	1 258 697
IMPORTS[2]							
2523.10	Cement clinker						
	Turkey	–	–	–	–	163 339	6 848
	United Arab Emirates	–	–	–	–	95 951	5 086
	Spain	–	–	23 693	1 126	62 522	2 868
	Switzerland	–	–	–	–	34 629	2 088
	Mexico	78 802	3 711	7 991	355	5 539	247
	United States	288	24	331	14	624	25
	Lebanon	10 995	479	190 365	8 841	–	–
	Thailand	76 507	4 743	–	–	–	–
	Bermuda	20 811	1 018	–	–	–	–
	Total	187 403	9 975	222 380	10 336	362 604	17 162
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	13 157	2 529	13 403	2 716	14 059	3 049
	Denmark	132	36	3 059	421	5 157	715
	Mexico	2 690	493	38 784	3 736	1 141	216
	Bermuda	–	–	19 380	877	–	–
	Other countries	597	96	6	1	81	14
	Total	16 576	3 154	74 632	7 751	20 438	3 994
2523.29	Portland cement, n.e.s.						
	United States	495 375	39 944	455 956	37 001	505 985	42 177
	United Kingdom	43	5	–	–	570	55
	Mexico	753	75	578	45	593	54
	France	2 123	170	244	25	2	...
	Croatia	–	–	781	61	–	–
	Lebanon	5 450	597	–	–	–	–
	Colombia	2 757	300	–	–	–	–
	Other countries	174	10	58	4	145	12
	Total	506 675	41 101	457 617	37 136	507 295	42 298
2523.30	Aluminous cement						
	United States	13 602	8 086	13 662	7 999	12 581	7 700
	Croatia	–	–	185	91	1 689	1 014
	France	270	156	3	3	–	–
	Other countries	3	1	43	22	1	...
	Total	13 875	8 243	13 893	8 115	14 271	8 714
2523.90	Hydraulic cement, n.e.s.						
	United States	45 607	5 872	57 737	6 844	56 766	6 366
	China	634	72	14 374	1 515	19 916	2 071
	Belgium	9 770	2 279	5	1	17 867	1 987
	United Kingdom	3 636	715	2 360	494	3 098	597
	Croatia	–	–	148	35	692	131
	Japan	334	92	693	159	356	108
	France	210	52	564	110	444	77
	Other countries	1 104	147	159	31	742	185
	Total	61 295	9 229	76 040	9 189	99 881	11 522
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	..	2 801	..	3 632	..	2 931
	Brazil	..	61	..	126	..	219
	Other countries	..	50	..	38	..	48
	Total	..	2 912	..	3 796	..	3 198

TABLE 1 (cont'd)

Item No.		1998		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	17 620	. .	15 117	. .	17 043
	Italy	. .	1 356	. .	978	. .	1 105
	Spain	. .	128	. .	109	. .	401
	Portugal	. .	132	. .	91	. .	139
	China	. .	16	. .	15	. .	41
	Mexico	. .	14	. .	29	. .	24
	Netherlands	. .	. . .	. .	63	. .	22
	Israel	. .	41	. .	. . .	. .	22
	Other countries	. .	354	. .	113	. .	84
	Total	. .	19 661	. .	16 515	. .	18 881
6810.20	Pipes of cement or concrete	–	–	–	–	–	–
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	6 909	. .	3 177	. .	2 507
	United Kingdom	. .	899	. .	503	–	–
	Other countries	. .	116	. .	14	. .	1
	Total	. .	7 924	. .	3 694	. .	2 508
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	16 695	. .	17 065	. .	19 746
	China	. .	3 985^r	. .	3 854	. .	5 976
	Mexico	. .	333	. .	607	. .	933
	United Kingdom	. .	1 103	. .	742	. .	801
	Belgium	. .	. . .	–	–	. .	687
	Malaysia	. .	8^r	. .	480	. .	348
	South Korea	. .	9	. .	150	. .	226
	Germany	. .	100	. .	71	. .	183
	Italy	. .	87	. .	222	. .	163
	Indonesia	. .	8	. .	6	. .	75
	Philippines	. .	220^r	. .	264	. .	64
	Hong Kong	. .	215	. .	187	. .	28
	Other countries	. .	96^r	. .	214	. .	277
	Total	. .	22 859^r	. .	23 862	. .	29 507
EXPORTS							
2523.10	Cement clinker						
	United States	1 657 808	93 004	1 236 860	87 794	805 870	64 224
	Total	1 657 808	93 004	1 236 860	87 794	805 870	64 224
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	481 690	51 239	179 837	32 251	180 730	32 480
	Other countries	197	50	106	34	29	42
	Total	481 887	51 289	179 943	32 285	180 759	32 522
2523.29	Portland cement, n.e.s.						
	United States	3 745 080	258 042	4 083 662	313 797	3 915 926	310 706
	Saint Pierre and Miquelon	361	63	–	–	11	15
	Iceland	–	–	200	23	–	–
	South Korea	–	–	316	24	–	–
	Other countries	20	12	52	13	19	15
	Total	3 745 461	258 117	4 084 230	313 857	3 915 956	310 736
2523.30	Aluminous cement	–	–	–	–	–	–
2523.90	Hydraulic cement, n.e.s.						
	United States	72 106	12 533	22 742	3 594	4 404	2 074
	Jamaica	–	–	74	62	427	217
	Peru	–	–	2	3	41	68
	Germany	–	–	–	–	160	41
	Chile	123	71	105	68	–	–
	Other countries	183	154	71	40	157	114
	Total	72 412	12 758	22 994	3 767	5 189	2 514

TABLE 1 (cont'd)

Item No.		1998		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	. .	35 964	. .	53 908	. .	64 993
	Ukraine	. .	156	. .	73	. .	217
	Japan	. .	178	. .	234	. .	98
	France	–	–	–	–	. .	74
	Taiwan	. .	257	–	–	–	–
	Other countries	. .	89	. .	120	. .	62
	Total	. .	36 644	. .	54 335	. .	65 444
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	23 226	. .	33 415	. .	55 053
	Turkey	–	–	. .	2 501	. .	1 871
	Japan	. .	2 484	. .	1 888	. .	606
	Belgium	–	–	–	–	. .	131
	Cuba	–	–	. .	11	. .	119
	Australia	–	–	. .	1 275	–	–
	Other countries	. .	36	. .	99	. .	68
	Total	. .	25 746	. .	39 189	. .	57 848
6810.20	Pipes of cement or concrete	–	–	–	–	–	–
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	68 593	. .	115 800	. .	96 851
	United Kingdom	. .	84	–	–	. .	790
	France	–	–	. .	207	. .	252
	Venezuela	–	–	–	–	. .	192
	Australia	–	–	–	–	. .	179
	Guatemala	. .	538	–	–	–	–
	Other countries	. .	151	. .	121	. .	106
	Total	. .	69 366	. .	116 128	. .	98 370
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	45 217	. .	48 593	. .	71 158
	Cuba	. .	35	–	–	. .	1 208
	France	. .	37	. .	528	. .	515
	Belgium	–	–	. .	16	. .	279
	United Kingdom	. .	1 975	. .	1 726	. .	275
	Bermuda	. .	34	–	–	. .	223
	South Korea	–	–	–	–	. .	99
	Japan	. .	63	. .	43	. .	83
	Italy	. .	250	–	–	. .	79
	Honduras	. .	177	–	–	–	–
	Other countries	. .	230	. .	50	. .	102
	Total	. .	48 018	. .	50 956	. .	74 021

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; ^{p} Preliminary; ^{r} Revised; x Confidential.
[1] Producers' shipments plus quantities used by producers; [2] Includes re-imports.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CEMENT PLANTS, APPROXIMATE ANNUAL GRINDING CAPACITY, END OF 1999

Company	Plant	Wet (W) Dry (D) Preheater (x) Precalciner (c)	Fuel (Coal, Oil, Gas, Waste)	No. of Kilns	Grinding Capacity	Clinker Capacity
					(000 t/y)	
ATLANTIC REGION						
Lafarge Canada Inc.	Brookfield, N.S.	D	C,Wa	2	536	485
North Star Cement Limited	Corner Brook, Nfld.	Dx	O,Wa	1	250	146
Subtotal, Atlantic region				3	786	631
QUEBEC						
Lafarge Canada Inc.	St. Constant	D	Wa,C,O,G	2	1 129	950
Ciment Québec Inc.	St. Basile	Dx	C,O,G,Wa	1	995	759
St. Lawrence Cement Inc.	Joliette	D	C,Wa	4	1 475	900
Subtotal, Quebec region				7	3 599	2 609
ONTARIO						
Lafarge Canada Inc.	Woodstock	W	C,G	2	775	525
	Bath	Dc	C	1	1 090	987
Federal White Cement Ltd.	Woodstock	Dx	O,G	1	450	230
ESSROC Canada Inc.	Picton	D,Dx	C,G	2	746	1 156
St. Lawrence Cement Inc.	Mississauga	W,Dc	C,O,Wa	3	2 009	1 759[a]
Blue Circle Canada Inc.	Bowmanville	Dc	C	1	1 305	1 744
	St. Marys	Dx	C,G,Wa	1	685	738
Subtotal, Ontario region				11	7 060	7 123
PRAIRIE REGION						
Lafarge Canada Inc.	Exshaw, Alta.	D,Dc	G	2	1 519	1 209
Inland Cement Limited (Cimenteries CBR/Heidelberger)	Edmonton, Alta.	Dc	G	1	1 380	961
Subtotal, Prairie region				3	2 899	2 170
BRITISH COLUMBIA						
Lafarge Canada Inc.	Kamloops	D	C,G	1	259	194
	Richmond	Dc	C,G	1	616	939
Tilbury Cement Limited (Cimenteries CBR/Heidelberger)	Delta	Dx	C,G,Wa	1	1 050	1 148
Subtotal, B.C. region				3	1 925	2 281
Total Canada (9 companies)				27	16 269	14 814

Source: Market and Economic Research Department, Portland Cement Association.
[a] Two kilns inactive.
Note: Total active kiln capacity including white cement is approximately 14.3 Mt/y.

TABLE 3. CANADA, CEMENT PLANTS, KILNS AND CAPACITY UTILIZATION, 1980-2000

	Clinker-Producing Plants	Kilns	Approximate Cement Grinding Capacity	Portland and Masonry Cement Production[1]	Clinker Exports	Approximate Total Production[2]	Capacity Utilization
			(t/y)	(t)	(t)	(t)	(%)
1980	23	47	16 363 000	10 274 000	726 087	11 000 087	67
1981	23	48	16 771 000	10 145 000	524 006	10 669 006	64
1982	23	48	16 771 000	8 418 000	290 329	8 708 329	50
1983	23	49	17 900 000	7 870 878	404 793	8 275 671	46
1984	23	49	17 900 000	9 387 466	440 297	9 827 763	55
1985	23	49	17 900 000	10 192 442	676 596	10 869 038	61
1986	23	49	17 900 000	10 611 223	324 000	10 935 223	61
1987	20	40	16 600 000	12 603 164	767 338	13 370 502	81
1988	20	40	15 506 000	12 349 873	331 796	12 681 669	82
1989	20	38	15 546 000	12 590 637	178 491	12 769 128	82
1990	20	38	16 439 000	11 745 152	460 075	12 205 227	74
1991	20	34	16 262 000	9 372 219	544 870	9 917 089	61
1992	18	34■	16 800 000	8 593 399	988 348	9 581 747	57
1993	18	34■	16 800 000	9 393 581	882 935	10 276 516	61
1994	18	34■	17 021 000[r]	10 584 414	981 024	11 565 438	68
1995	18	34■	16 157 000[r]	10 440 329	1 329 548	11 769 877	69
1996	18	32	16 252 000	11 587 365	1 252 863	12 840 228	79
1997	17	30	15 856 000	11 736 272	1 019 308	12 755 580	80
1998	17	28	15 837 000	12 124 058	1 657 808	13 781 866	87
1999	17	27	16 269 000	12 634 440	1 236 860	13 871 300	85
2000[p]	17	27	16 300 000	12 612 000	806 000	13 418 000	82

Sources: Statistics Canada; Portland Cement Association.
[p] Preliminary; [r] Revised.
■ Includes inactive kilns.
[1] Producers' shipments and amounts used by producers. [2] Cement shipments/production plus clinker exports.

TABLE 4. CANADA, PRODUCTION AND USE OF COAL COMBUSTION PRODUCTS (CCPs), 2000[1,2]

	Fly Ash	Bottom Ash	FGD Gypsum	Other[3]	Total CCPs
	(000 tonnes)				
PRODUCTION					
Produced	5 030	1 558	421	128	7 137
Removed from disposal	–	138	–	–	138
Disposed/stored	3 985	1 472	–	124	5 582
USE (DOMESTIC)					
Cement	491	143	–	–	634
Concrete/grout	400	–	–	–	400
Mining applications	136	–	–	–	136
Roadbase/subbase	20	49	–	–	69
Wallboard	–	–	570	–	570
Other[4]	46	5	–	–	51
Total use	1 094	196	570	–	1860
Individual use percentage	22%	13%	135%	–	n.a.
Cumulative use percentage	22%	20%	27%	26%	26%

Sources: Natural Resources Canada; Canadian Electricity Association.
– Nil; n.a. Not applicable; FGD Flue-gas desulphurization.
[1] Production of coal combustion products (CCPs) includes both dry and ponded categories. [2] Use (domestic) includes amounts imported (assumed HS codes 2621.00 relating to fly ash, and 2520.10 relating to gypsum). [3] Cfb (circulating fluidized bed) fl ash and bottom ash. [4] Relates to uses such as waste stabilization, oil well reclamation/cementing agent, microspheres and roofing tiles.

TABLE 5. CANADA, VALUE OF CONSTRUCTION BY TYPE, 1996-2000

	1996	1997	1998	1999	2000
			($ millions)		
BUILDING CONSTRUCTION					
Residential investment	32.3	36.5	36.0	38.8	40.8
Non-residential building investment	19.6	22.5	22.4	24.2	25.3
Total building construction	51.9	59.0	58.4	63.0	66.1
ENGINEERING CONSTRUCTION					
Mining and oil and gas extraction	13.9	18.2	16.7	15.4	19.3
Transportation and warehousing	2.0	2.2	5.0	5.0	4.1
Other engineering	15.2	14.7	14.5	16.6	18.3
Total engineering construction	31.1	35.1	36.2	37.0	41.7
Total components	83.0	94.1	94.6	100.0	107.8

Sources: Natural Resources Canada; Statistics Canada, CANSIM II (Table 026-0013 – Residential Values, by Type of Investment and Related Table 031-0002 – Flows and Stocks of Fixed Non-Residential Capital, by North American Industry Classification System). (More information can be obtained on the Internet at the CANSIM II site at http://www.statcan.ca/english/CANSIM.)
Notes: Numbers may not add to totals due to rounding. Expenditures include value of new construction and major renovation work purchased.

TABLE 6. WORLD PRODUCTION OF CEMENT, 1999 AND 2000e

	1999	2000e
	(000 tonnes)	
Canada	12 634	12 600
Brazil	40 270	41 500
China	573 000	576 000
Germany	38 099	37 000
India	90 000	95 000
Italy	36 000	35 000
Japan	80 120	77 500
South Korea	48 157	50 000
Russia	28 400	30 000
Spain	30 800	30 000
Thailand	34 500	38 000
Turkey	34 403	33 000
United States	87 777	92 300
Other countries	475 589	556 400
Total world	1 609 749	1 704 300

Sources: Natural Resources Canada; U.S. Geological Survey, January 2001.
e Estimated.

Copper

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The recovery in prices that began in the third quarter of 1999 continued over the course of 2000, driven by strong demand during the first half of the year and falling stock levels from the second quarter onward. Despite a dramatic decline in economic activity in the United States during the fourth quarter of 2000, global demand for refined copper grew by 7.5% in 2000, according to data published by the International Copper Study Group. This compares to an average long-term use growth rate of 3.3% per year. The supply of refined copper grew by a more modest 2.3% in 2000, and these market fundamentals produced a metal deficit of 457 000 t. The London Metal Exchange (LME) cash settlement price for Grade A copper averaged US$1813/t (US82.4¢/lb) in 2000, a 15.3% increase from 1999.

CANADIAN DEVELOPMENTS

Canada's provisional mine production of copper in 2000 totaled 622 300 t, about 7% higher than the 1999 total of 583 800 t (mine production figures are based on recoverable copper in concentrate shipped). Full production from the Highland Valley and Myra Falls mines, both of which were shut down temporarily in 1999, was offset by lower output from Falconbridge Limited's mines due to a strike at the Sudbury operations and lower ore grades at Kidd Creek. Canada's provisional production of refined copper metal in 2000 totaled 551 400 t, about 2% higher than the 540 500 t produced in 1999. In 2000, Canada ranked fifth in the world in terms of mine production (Table 3).

Quebec

In May, Breakwater Resources Ltd. acquired the Bouchard-Hébert and Langlois mines, located in northwestern Quebec, from Cambior inc. Earlier in the year, Cambior had announced mechanical problems with the semi-autogenous grinding (SAG) mill at the Bouchard-Hébert mine, which resulted in a temporary shut-down of the mill. The repaired SAG mill was back in production in October and reached full capacity of 2900 t/d by year-end. In November, Breakwater announced that it would be temporarily suspending operations at the Langlois mine due to operating problems associated with the main ore pass system. In 1999, the Bouchard-Hébert mine produced 7200 t of copper in concentrate and the Langlois mine produced 1000 t of copper in concentrate.

Ontario

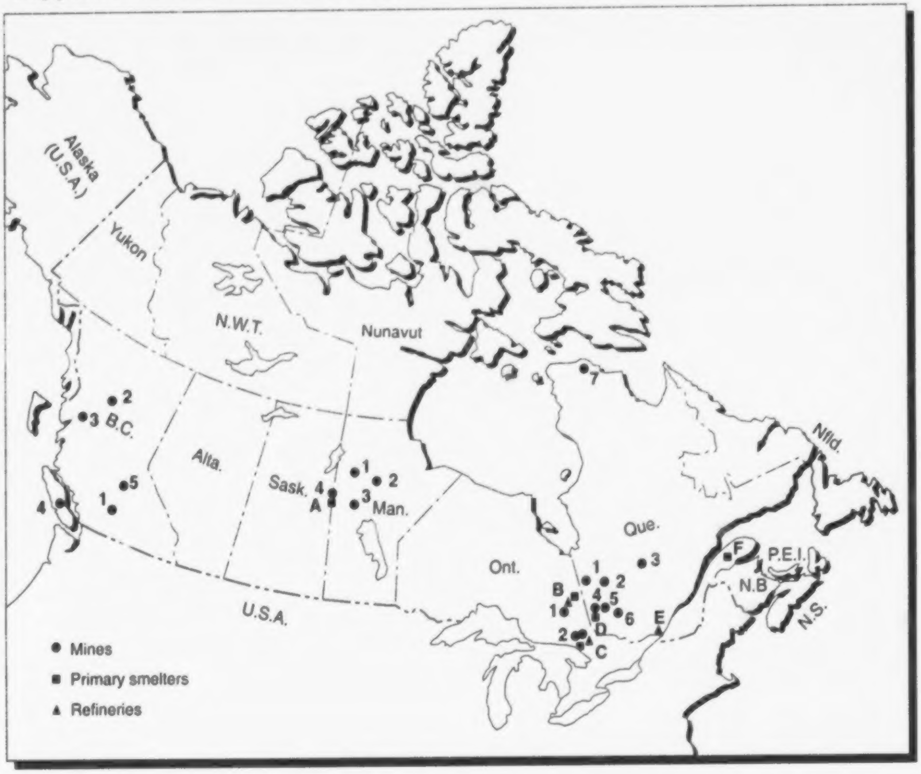
In July, Falconbridge announced that it will proceed with a $640 million project to extend the depth of its Kidd Creek mine in Timmins, Ontario, by 1000 m to a total depth of 3100 m. At the new depth, the Kidd Creek mine will be the world's deepest base-metal mine. The extension is expected to contribute 2 Mt of ore annually when full production levels are reached. Production is expected to begin in 2004.

Falconbridge Limited and the production and maintenance workers in Sudbury (Canadian Auto Workers CAW Local 598) signed a 35-month collective agreement on February 20, 2001, ending a six-and-a-half-month strike.

Manitoba

A series of explosions in the main smelting furnace at Hudson Bay Mining and Smelting Co., Limited's Flin Flon, Manitoba, metallurgical complex on August 8, 2000, forced the company to shut down copper smelting operations and declare force majeure on copper shipments for a period of almost three months. The explosion was triggered when water being used to cool the furnace in preparation for rebricking came into contact with molten metal. One worker was killed and thirteen others were injured. Force majeure was lifted on November 27. The rated capacity of the smelter is 90 000 t/y of copper.

Figure 1
Copper Producers in Canada, 2000



Numbers refer to locations on map above.

MINES

BRITISH COLUMBIA

1. Highland Valley Copper
2. Northgate Exploration Ltd. (Kemess)
3. Imperial Metals Corporation (Huckleberry)
4. Boliden Limited (Myra Falls)
5. Imperial Metals Corporation (Mount Polley)

SASKATCHEWAN

Hudson Bay Mining and Smelting Co.,Limited (Flin Flon)

MANITOBA

1. Hudson Bay Mining and Smelting Co., Limited (Ruttan mine)
2. Inco Limited (Thompson mine)
3 Hudson Bay Mining and Smelting Co., Limited (Photo Lake mine)
4. Hudson Bay Mining and Smelting Co., Limited (Flin Flon area mines including Konuto Lake)

ONTARIO

1. Falconbridge Limited (Timmins)
2. Falconbridge Limited (Sudbury area)
   Inco Limited (Sudbury area)

QUEBEC

1. Les Mines Selbaie (Billiton Base Metals)
2. Noranda Inc. (Bell Allard mine)
3. Campbell Resources Inc. (Joe Mann mine)
4. Breakwater Resources Ltd. (Bouchard-Hébert mine)
5. Agnico-Eagle Mines Limited (La Ronde mine)
   Barrick Gold Corporation (Bousquet mine)
6. Aur Resources, Inc., Novicourt Inc., Teck Corporation (Louvicourt mine)
7. Falconbridge Limited (Raglan)

NEW BRUNSWICK

Noranda Inc. (Brunswick mine)

PRIMARY SMELTERS

A. Hudson Bay Mining and Smelting Co., Limited (Flin Flon)
B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
   Falconbridge Limited (Sudbury area)
D. Noranda Inc. (Noranda)
F. Noranda Inc. (Gaspé)

REFINERIES

B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
E. Noranda Inc. (CCR Division)

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[1] Highland Valley Copper is a partnership of Cominco Ltd., Teck Corporation and Rio Algom Limited.

British Columbia

In October, Cominco Engineering Services Ltd. signed a memorandum of understanding with Taseko Mines Limited to begin a $3 million study to investigate the feasibility of constructing a 35 000-t/y copper refinery at the Gibralter mine site near Williams Lake, British Columbia. The refinery would use Cominco's hydro-metallurgical technology to leach copper concentrate. The study will be completed in early 2001.

In November 2000, London-based Billiton Plc acquired 100% control of Toronto-based Rio Algom Limited. Rio Algom's operations in Canada include a 33.6% partnership interest in the Highland Valley Copper (HVC) copper mine in British Columbia. Rio Algom's other copper interests include a 100% interest in the Cerro Colorado mine in northern Chile, a 25% interest in the Alumbrera copper-gold mine in Argentina, and a 33.75% interest in the Antamina copper-zinc mine in Peru. Billiton's operations in Canada include Les Mines Selbaie, a wholly owned copper-zinc mine located in northwestern Quebec. Following exhaustion of current ore reserves, processing is expected to continue at Selbaie until June 2004 from low-grade ore stockpiled during the mining period. A trust fund is also in place to guarantee closure and reclamation costs.

WORLD DEVELOPMENTS

World mine production of copper was 13.2 Mt in 2000 compared to 12.7 Mt in 1999 (Table 3). During 2000, world production of refined copper (which includes refined copper from both primary and recycled material) increased to 14.8 Mt from 14.5 Mt in 1999 (Table 4). The price recovery had a positive effect on copper scrap supplies in 2000. Within the total world production of refined copper, the recycled component increased slightly to 2.1 Mt in 2000.

Chile

Total Chilean copper mine production in 2000 was 4.6 Mt, a 5% increase over 1999 production. Chile is the world's largest copper producer and its output accounted for 35% of total world copper mine production in 2000. Approximately two thirds of 2000 output came from private-sector producers, with the remaining one third coming from the Corporacion Nacional del Cobre de Chile (Codelco-Chile), the state-owned copper producer. Planned expansions announced during 2000, anticipated new projects, and further exploration should ensure that Chile maintains its dominant position in the world copper industry.

Codelco-Chile announced in August that it will invest US$640 million to expand production at the El Teniente Division by 130 000 t/y to 480 000 t/y by 2003.

In February, Noranda Inc. announced plans to proceed with a US$170 million, two-stage expansion of its Altonorte smelter located in northern Chile. The first stage will involve a technology upgrade of some equipment by the end of 2001. The second stage comprises an expansion from 160 000 t/y to 290 000 t/y of anode and blister and will be completed in early 2003.

In November, BHP Limited (BHP) and its joint-venture partners in the Escondida copper mine in northern Chile announced the approval of the US$1 billion Phase IV expansion project. The project will increase average annual copper production by 400 000 t to 1.2 Mt/y over the first five years of full production. The expansion will be completed by the end of 2002. Escondida is owned by BHP of Australia (57.5%), Rio Tinto of the United Kingdom (30%), and the Japanese consortium, Jeco, led by Mitsui & Co., Ltd. (10%) and the International Finance Corporation (IFC) (2.5%).

Japan

Sumitomo Metal Mining Co., Ltd. announced plans in April to raise copper production from 230 000 t/y to 400 000 t/y by 2005.

Indonesia

On May 4, 2000, a waste-water spill occurred at the Grasberg mine's Wanagon Basin at the Grasberg main complex in Irian Jaya, Indonesia, the third such incident since 1998 according to BAPADEL, Indonesia's environment agency. Following the spill, acting on a recommendation from the Indonesian government, the mine's owners, P.T. Freeport Indonesia Company (PTFI), made a small production cut from the open pit to reduce environmental pressures from tailings and overburden. In addition, overburden dumping in Lake Wanagon was halted and geotechnical studies were ordered and will be reviewed by Freeport and local and national government agencies to determine the longer-term implications of the spills on current and future operations. The Grasberg complex is the world's largest gold-copper mine. In 1999, it produced 1 630 700 t of copper.

Zambia

Government-owned Zambia Consolidated Copper Mines Limited (ZCCM) completed the privatization of Zambia's largest and most promising mining and metallurgical assets. The sale was made under two separate agreements. The first was the sale of ZCCM's Mufulira Division and part of the Nkana Division to a new company called Mopani Copper Mines, formed by a consortium comprising Canadian-based First Quantum Minerals Ltd. (44%), Swiss-based Glencore International AG (46%), and ZCCM

(10%). The second transaction was the sale of the Konkola Division, including the Konkola Deep project, the Nchanga Division and the Nampundwe pyrite mine, to a newly formed company called Konkola Copper Mines, owned 65% by Anglo American plc's subsidiary Zambian Consolidated Investments Limited, 20% by ZCCM, and 15% by the World Bank's Commonwealth Development Corporation and the IFC (7.5% each).

Peru

In November 2000, Cambior announced the sale of its La Granja copper project in Peru to Billiton for approximately $37.5 million.

United States

After failing to find a buyer for its Atlanta-based Carrollton copper refinery, Southwire announced in April that it now plans to close the facility. The plant used 200 000 t/y of recycled copper when running at full capacity. Industry analysts cited the cost of compliance with metro Atlanta's environmental regulations as a factor in the closure. Southwire's rod mill will continue to operate.

Copper Usage

World copper usage increased to 15.3 Mt in 2000 from 14.2 Mt in 1999 (this includes refined copper from both primary and recycled material). Canadian refined copper usage increased to 274 000 t in 2000 from 266 500 t in 1999 (Table 5).

Copper's properties, particularly its high electrical and thermal conductivity, good tensile strength, elevated melting point, non-magnetic properties and resistance to corrosion, make it and its alloys very attractive for electrical transmission, water tubing, castings and heat exchangers. Copper is the most efficient conductor of electrical power, signals and heat of all the industrial metals. In Canada, more than half of the refined copper consumed annually is used for electrical applications, mostly as wire. Copper's surface lustre makes it attractive for sculpting, jewellery and architectural applications.

According to figures compiled by CRU International Limited, 75% of copper is used in wire and cable, of which two thirds is used in energy cables (power cables, building wire, etc.). The next largest market is magnet wire, used in cars and appliances, which has shown rapid growth in recent years. Of the copper used annually, 22% is manufactured into tube, sheet and rod for use in various applications, including building construction, industrial machinery and equipment, and consumer and general products.

Table 8 presents preliminary end-use data for 1999 and 2000 for the United States collected by the Copper Development Association Inc. (detailed statistics on copper use are not officially collected in Canada).

MARKETS

In Canada, copper tube and fittings are now being used in houses and other buildings to carry natural gas. The growth of this market has been dramatic, with copper quickly becoming the preferred material, replacing steel pipe. This market is being heavily promoted by the Canadian Copper & Brass Development Association (CCBDA) with the financial support of the ICA. The CCBDA will make special promotional efforts in areas of eastern Canada that have recently gained, or will soon gain, access to natural gas distribution. The CCBDA and the Copper Development Association Inc. of the United States have also jointly undertaken major North American initiatives on the promotion of plumbing tube and fittings, as well as architectural applications.

In addition, the CCBDA is actively involved in the promotion of electrical wire and cable, with particular emphasis on the use of larger conductors to improve energy efficiency and power quality, and on industrial and commercial power cable for building applications.

In recent years, copper has benefited from increasing consumer demand for large and small appliances, household convenience items, computers, and automotive options. In North America, there has been a noticeable increase in the intensity of copper use in residential applications. Part of this change is attributable to the construction of larger houses and the growth of home-based offices. In many homes there is a need for multiple phone lines to handle faxes, modems and security systems.

Although the use of fibre-optic cable in the communications and telecommunications sectors has increased in recent years, the development of new technologies has permitted copper wire to remain competitive, particularly in low-density applications, including communication connections to individual homes and for internal network links such as desk-to-desk telephone and computer connections.

The use of additional electronics has also stimulated growth in demand for copper wire from the automotive industry in recent years. However, the introduction of multiplex electronic systems could limit copper demand in this application.

With technological advances and design innovations, new brazed copper-brass radiators have been developed that are 35-40% lower in weight than traditional copper-brass radiators. According to the ICA, these brazed radiators are produced more easily and at a lower cost than comparable aluminum radiators.

A number of other promising new markets for copper could also provide significant growth opportunities. These include the use of copper as an additive in roofing shingles to prevent the formation of algae and fungus and its use in fire suppression systems, natural gas systems, solar power generation equipment, and the storage of spent nuclear fuel.

Copper Recycling

There were 5 153 000 t of scrap copper recovered in 1999. Copper scrap recovery includes the production of both recycled refined copper and the direct scrap copper used by manufacturers. The United States is the largest source of scrap copper; it is estimated that the United States recovered 1 297 000 t of scrap copper in 1999. According to annual surveys conducted by Natural Resources Canada, a total of 107 000 t of contained copper in scrap was recovered in Canada in 1999.

The useful service life of copper-containing products is estimated to be 35 years for residential housing, 30 years for electrical plants, 15 years for non-electrical machinery, 10 years for transportation applications, and generally 10 years for other end uses. Due to the long life of many consumer and industrial products containing copper, the calculation of pure recycling rates presents a challenge. The Statistical Committee of the International Copper Study Group is proposing to focus on obtaining more reliable and comprehensive statistics on the production and use of scrap copper. In Canada, Statistics Canada and Natural Resources Canada are working jointly to improve data on metals recycling. New recycling data for the major metals recycled in Canada, including copper, will be available in early 2003 for the reference year 2001.

Scrap copper competes directly with primary forms. Smelters and refineries can, to some extent, substitute scrap for concentrate or blister copper. Foundries and other consumers may use either primary refined copper or scrap. Scrap copper accounts for 35-40% (Table 11) of the raw material input of global refined copper production.

Copper wire is the single most important source of copper scrap. For recovery purposes, scrap copper is segregated into four principal categories: No. 1 copper wire, No. 2 copper wire, No. 3 copper wire, and copper-bearing scrap. The differentiation between No. 1 and No. 2 copper wire relates to the minimum copper content of the wire. Other major sources of scrap copper include copper tubing, electrical motors and copper sheeting. Copper scrap also arises in the form of residues and can be recovered from metallurgical compounds, metallic dusts, electronic scrap, copper-containing ashes, and copper-containing sludges. Bronze alloys contain varying percentages of copper and tin as their principal elements. They may also contain smaller proportions of both lead and zinc. Brass alloys contain copper and zinc as their principal elements and may also contain smaller proportions of both tin and lead. Brass and bronze scrap arises in forms such as water valves, plumbing fixtures, auto radiators, cast machinery, train brake linings, ship propellers, brass pipes, water condenser tubes, and lighting fixtures.

The recovery of copper from recycled sources can have significant energy savings when compared to the production of primary copper.

RELATIVE ENERGY REQUIREMENTS TO PRODUCE COPPER FROM VARIOUS SOURCES (PRIMARY = 100)

Copper Source	Energy Requirements
	(%)
No. 1 scrap copper	3
No. 2 scrap copper	14
Copper-bearing scrap	35
Brass and bronze scrap	6

Source: Kusik & Kenahan, *Energy Use Patterns for Metal Recycling.*

COPPER AND HEALTH

Copper is essential to plant, animal and human health. Deficiencies, as well as excesses, can be detrimental to health. At a Task Group meeting of the International Programme on Chemical Safety (IPCS) held in Brisbane in June 1996, there was a recognition that copper is an essential trace element for human health and that there are greater risks, in Europe and the Americas in particular, of health effects from copper deficiency than from excess copper intake.

The World Health Organization (WHO) has suggested a recommended daily intake of copper of 130 to 200 micrograms (μg) of copper per kg of body weight for infants from birth to six months, 80 to 120 μg/kg for infants over six months and young children up to age 10, and 30 to 60 μg/kg for children of 10 years and above and adults.

Acute copper poisoning is infrequent in humans, largely restricted to the voluntary or accidental ingestion of copper salts. According to the Copper Development Association Inc., the WHO and the U.S. Food and Agricultural Administration (FAA) are likely to suggest that the population's mean intake of copper should not exceed 12 mg/d for adult males and 10 mg/d for adult females. These levels are regarded as the lowest intake levels likely to produce the slightest biochemical evidence of undesirable effects in all but a small number of the population.

Sources of dietary copper include liver and other organ meat, pork and beef, vegetables (potatoes, peas, beans, lettuce and tomatoes), seafood (oysters, shrimp, trout, flounder and tuna), chocolate, nuts, grains, seeds and fruit.

Many regulatory agencies, including Health Canada, have chosen 1 part per million (ppm) as the maximum desirable concentration of copper in drinking water. It signifies more of an aesthetic limit than a health limit; water containing more than 1 ppm can stain laundry and persons with a keen sense of taste may perceive a metallic flavour in the water.

In 1993, the WHO included copper in a group of chemicals of health significance in drinking water and recommended a guideline value of 2 mg/L. The recommendation was deemed provisional due to uncertainties regarding copper toxicity in humans. As a result, scientific discussions were conducted internationally and the WHO revised its recommendation in 1997 with the guideline value of 2 mg/L for copper now defined on the basis of the potential for acute gastrointestinal effects. The recommendation remains provisional in view of the remaining uncertainties regarding copper toxicity in humans.

STOCKS

Combined copper stocks on the London Metal Exchange (LME), the Commodities Exchange, Inc. (COMEX) and the Shanghai Metal Exchange declined substantially during the year. At the end of December 2000, stocks at the above-mentioned metal exchanges stood at 523 700 t, compared to 936 500 t at the end of 1999.

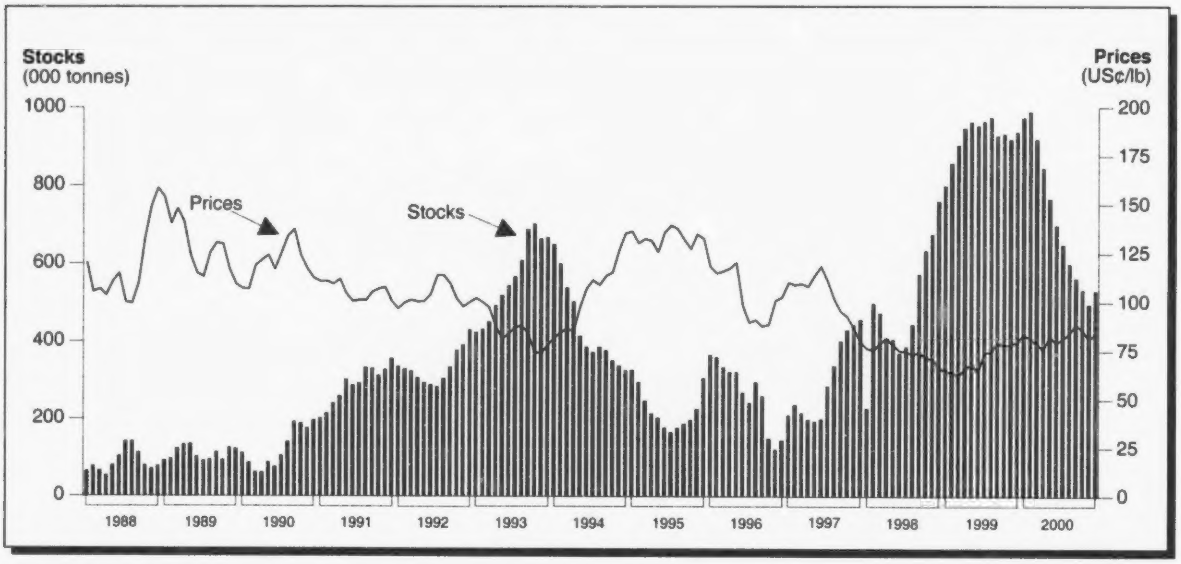
Total copper stocks, including those at producers, merchants, consumers and exchanges, totaled 1 230 800 t at the end of 2000, compared to 1 619 000 t at the end of 1999. Figure 2 shows both total copper stocks and prices for the period 1990-2000.

PRICES

Copper prices on the LME averaged US$1813/t (US82.4¢/lb) in 2000 (Figure 2), compared to US$1573/t (US71¢/lb) in 1999.

Figure 2

Copper Prices[1] and Exchange[2] Stocks, 1988-2000



Source: Natural Resources Canada.

[1] Average monthly LME cash prices. [2] Combined exchange stocks at end of the month.

OUTLOOK

Copper prices have been declining in 2001, mainly due to a substantial slowdown in demand for copper in the first six months of 2001 brought about by a sharp drop in economic activity in most of the major copper-using regions (the United States, Europe and Asia). While global growth in demand for copper in 2000 was a very healthy 7.5%, current forecasts indicate that demand growth will be negative in 2001 ranging from -0.8% to -3.5%. This compares with an increase in supply in 2000 of 2.3% and a forecast increase in growth in supply in 2001 of 3.9%.

The decline in demand has pushed the supply/demand balance for copper metal from a deficit in 2000 of 457 000 t to a surplus at the end of June 2001 of 100 000 t. In addition, by mid-2000, stock levels at exchanges had begun to rise dramatically as manufacturers/fabricators destocked or reduced inventories in response to weakening demand for their products. These supply/demand fundamentals drove the copper price down from US81¢/lb (or US$1794/t) in the first quarter of 2001 to US66¢/lb (US$1485/t) by the end of August. This period of destocking is expected to come to an end; however, any sustained recovery in price will be tied to the recovery in global economies. The key factor will be the timing of a recovery in the North American economy and the extent of demand in China. North America accounts for 25% of refined copper use but more than this is imported in the form of semi-fabricated products and finished goods. China will continue to be the swing factor in determining whether copper markets are in a surplus or deficit. In 2000, China's use of copper metal accounted for 12% of global demand. Chinese copper use is still growing rapidly and will continued to outpace increases in China's production capacity. Therefore, the extent of China's need to import copper will continue to influence copper prices.

Currently, most analysts are forecasting prices to decline somewhat further in the third quarter of 2001 to the US62¢-64¢/lb level before recovering, based on the assumption that the decline in industrial production has reached an end and that demand for copper will begin to recover in the fourth quarter of 2001. For the full year of 2001, prices are forecast to average in the US73¢-75¢/lb range, or US$1600-$1654/t.

Looking ahead to 2002, growth in use is expected to reach 5-5.5% while growth in supply is expected to reach between 3 and 3.5%. This should bring the supply/demand back into balance; however, the overhang of metal stocks will dampen the price recovery. Thus, in 2002, the copper price is expected to average around US80.5¢/lb (US$1775/t). Beyond 2002, the price outlook becomes much more bullish as growth in demand is anticipated to outstrip supply. This could push prices up to the US$1.00/lb level (US$2205/t) in the 2003/04 period.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review, used for the outlook for copper markets, was current as of August 15, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States	EU	Japan[1]
		MFN	GPT	USA	Canada	MFN	WTO
2603.00	Copper ores and concentrates						
2603.00.00.10	Copper content	Free	Free	Free	Free	Free	Free
2825.50	Copper oxides and hydroxides	Free	Free	Free	Free	3.2%	4.8%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
	Other sulphates:						
2833.25	Of copper						
2833.25.10	Cupric sulphate	Free	Free	Free	Free	3.2%	3.9%
2833.25.90	Other copper sulphates	5.5%	Free	Free	Free	3.2%	3.9%
74.01	Copper mattes; cement copper (precipitated copper)						
7401.10	Copper mattes	Free	Free	Free	Free	Free	Free
7401.20	Cement copper (precipitated copper)	Free	Free	Free	Free	Free	Free
7402.00	Unrefined copper; copper anodes for electrolytic refining	Free	Free	Free	Free	Free	Free-3%
74.03	Refined copper and copper alloys, unwrought						
	Refined copper:						
7403.11	Cathodes and sections of cathodes	Free	Free	Free	Free	Free	Free-3%
7403.12	Wire bars	Free	Free	Free	Free	Free	Free-3%
7403.13	Billets	Free	Free	Free	Free	Free	Free-3%
7403.19	Other	Free	Free	Free	Free	Free	Free-3%
	Copper alloys:						
7403.21	Copper-zinc base alloys (brass)	Free	Free	Free	Free	Free	Free
7403.22	Copper-tin base alloys (bronze)	Free	Free	Free	Free	Free	Free-3%
7403.23	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel-silver)	Free	Free	Free	Free	Free	Free-3%
7403.29	Other copper alloys (other than master alloys of heading no. 74.05)	Free	Free	Free	Free	Free	Free-3%
7404.00	Copper waste and scrap	Free	Free	Free	Free	Free	Free
7405.00	Master alloys of copper	Free	Free	Free	Free	Free	3%
74.06	Copper powders and flakes	Free	Free	Free	Free	Free	3%
74.07	Copper bars, rods and profiles	Free-3%	Free	Free	Free	4.8%	3%
74.08	Copper wire, of refined copper	Free-3%	Free	Free	Free	4.8%	3%
74.09	Copper plates, sheets and strip, of a thickness exceeding 0.15 mm	Free	Free	Free	Free	4.8%	3%
74.10	Copper foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.15 mm	Free	Free	Free	Free	5.2%	3%
74.11	Copper tubes and pipes	2-2.5%	Free	Free	Free	4.8%	3%
74.12	Copper tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5.2%	Free
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated	3%	Free	Free	Free	Free-5.2%	3%
74.14	Cloth (including endless bands), grill and netting, of copper wire; expanded metal of copper	3%	Free	Free	Free	4.3%	Free
74.15	Nails, tacks, drawing pins, staples (other than those of heading no. 83.05) and similar articles, of copper or of iron or steel with heads of copper; screws, bolts, nuts, screw hooks, rivets, cotters, cotter-pins, washers (including spring washers) and similar articles, of copper	Free-3%	Free	Free	Free	3-4%	Free
7416.00	Copper springs	3%	Free	Free	Free	4%	Free
7417.00	Cooking or heating apparatus of a kind used for domestic purposes, non-electric and parts thereof, of copper	3%	Free	Free	Free	4%	Free
74.18	Table, kitchen or other household articles and parts thereof, of copper; pot scourers and scouring or polishing pads, gloves and the like, of copper; sanitary ware and parts thereof, of copper	3%	Free	Free	Free	3%	Free
74.19	Other articles of copper	Free-9.5%	Free-5%	Free	Free	3%	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (40th Annual Edition: 2000); *Custom Tariff Schedules* of Japan, 2000.

[1] WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, COPPER PRODUCTION AND TRADE, 1999 AND 2000

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	Newfoundland	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	10 636	24 984	9 423	25 507
	Quebec	133 669	313 989	92 778	251 150
	Ontario	206 798	485 768	203 711	551 446
	Manitoba	52 109	122 404	47 258	127 928
	Saskatchewan	174	408	625	1 692
	Alberta	–	–	–	–
	British Columbia	178 197	418 585	269 656	729 959
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	581 583	1 366 138	623 451	1 687 681
	Refinery output	548 563	. .	552 200	. .
EXPORTS					
2603.00.10	Copper ores and concentrates				
	Copper content				
	Japan	205 990	148 447	219 555	187 289
	China	–	–	147 342	113 334
	Philippines	28 092	16 768	47 541	37 255
	South Korea	34 711	24 729	32 423	24 741
	Other countries	2	3	33 267	24 778
	Total	268 795	189 947	480 128	387 397
2604.00.00.10, 2607.00.00.10, 2608.00.00.10, 2616.10.00.10	Other ores and concentrates				
	Copper content				
	Italy	1 798	1 467	–	–
	Total	1 798	1 467	–	–
2620.30	Copper ash and residues				
	United Kingdom	–	–	3 887	2 462
	United States	4	6	. . .	49
	Total	4	6	3 887	2 511
2825.50	Copper oxides and hydroxides	–	–	–	–
2833.25	Copper sulphates				
	United States	5 966	8 023	5 902	7 328
	Total	5 966	8 023	5 902	7 328
7401.10	Copper mattes				
	Norway	18 852	36 809	12 190	28 501
	United Kingdom	1 185	2 965	907	2 613
	United States	–	–	1	10
	Total	20 037	39 774	13 098	31 124
7401.20	Copper mattes; cemant copper (precipitated copper)				
	United States	–	–	20	82
	Total	–	–	20	82
7402.00	Copper anodes				
	United States	79 768	348 245	53 807	234 008
	Total	79 768	348 245	53 807	234 008

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	United States	258 304	623 105	267 774	762 729
	United Kingdom	25 049	52 565	13 164	40 602
	France	3 286	8 138	3 441	9 400
	Colombia	714	3 204	1 307	5 908
	Sweden	2 882	7 245	1 826	5 030
	Dominican Republic	–	–	316	1 444
	Taiwan	2 766	6 372	400	1 049
	Other countries	1 105	4 187	107	488
	Total	294 106	704 816	288 335	826 650
7403.21 to 7403.29	Other copper alloys				
	United States	2 826	7 645	3 137	8 884
	Spain	1	3	6	21
	Other countries	19	26	3	17
	Total	2 846	7 674	3 146	8 922
7404.00	Copper waste and scrap				
	United States	54 957	101 949	63 547	128 653
	China	3 509	3 346	6 063	8 542
	South Korea	387	570	1 206	1 713
	India	2 248	3 107	821	1 074
	Japan	199	255	311	817
	Hong Kong	770	923	362	684
	Belgium	2 550	881	213	75
	Other countries	533	998	574	1 144
	Total	65 153	112 029	73 097	142 702
7405.00	Master alloys of copper				
	United States	37	55	2	7
	Total	37	55	2	7
7406.10 to 7406.20	Copper powders and flakes				
	United States	39	483	46	283
	Taiwan	39	383	25	248
	Other countries	27	212	20	298
	Total	105	1 078	91	829
7407.10 to 7407.29	Copper bars, rods and profiles of refined copper				
	United States	8 779	35 866	9 956	43 687
	Chile	18	68	252	1 131
	Other countries	1 447	5 525	20	96
	Total	10 244	41 459	10 228	44 914
7408.11 to 7408.29	Copper and copper alloy wire				
	United States	101 381	261 804	116 427	359 083
	Argentina	–	–	29	400
	Other countries	83	598	20	175
	Total	101 464	262 402	116 476	359 658

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7409.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil				
	United States	13 320	61 924	16 205	77 698
	Thailand	268	970	787	3 236
	United Arab Emirates	132	539	700	3 006
	Saudi Arabia	658	2 720	544	2 502
	United Kingdom	765	2 519	681	2 474
	Jordan	402	1 528	471	2 028
	Other countries	1 860	7 464	1 992	8 655
	Total	17 405	77 664	21 380	99 599
7411.10 to 7411.29	Copper and copper alloy tubes and pipes				
	United States	17 814	90 773	21 300	116 250
	United Kingdom	84	752	267	2 008
	Chile	87	282	143	691
	Other countries	469	2 743	299	1 958
	Total	18 454	94 550	22 009	120 907
7412.10 to 7412.20	Copper and copper alloy tube and pipe fittings				
	United States	. .	22 743	. .	27 529
	Spain	. .	3 710	. .	3 647
	United Kingdom	. .	2 186	. .	2 501
	Germany	. .	6 729	. .	2 337
	Other countries	. .	4 913	. .	4 400
	Total	. .	40 281	. .	40 414
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated				
	United States	1 125	5 384	1 049	4 809
	Other countries	42	231	41	292
	Total	1 167	5 615	1 090	5 101
7414, 7415, 7416, 7419	Copper, other items of				
	United States	. .	30 257	. .	60 633
	United Kingdom	. .	59	. .	308
	Other countries	. .	885	. .	797
	Total	. .	31 201	. .	61 738
	Total exports		1 966 286		2 373 891
IMPORTS[2]					
2603.00.00.10	Copper ores and concentrates Copper content				
	Chile	52 846	95 601	103 304	202 662
	United States	37 868	72 352	45 585	98 844
	Argentina	20 152	34 892	14 365	29 004
	Indonesia	3 271	13 887	12 485	25 523
	Portugal	12 487	11 382	12 656	16 924
	Other countries	11 037	15 192	22 893	43 399
	Total	137 661	243 306	211 288	416 356

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
2604.00.00.10,	Other ores and concentrates				
2607.00.00.10,	Copper content				
2608.00.00.10,	United States	372	880	485	792
2616.10.00.10	Mexico	60	141	130	197
	Total	432	1 021	615	989
2620.30	Copper ash and residues				
	United States	14 129	26 617	13 190	14 097
	Sweden	21	1 419	257	2 593
	United Kingdom	901	2 894	585	1 283
	Bulgaria	15 118	9 028	–	–
	Other countries	7 844	12 965	310	973
	Total	38 013	52 923	14 342	18 946
2825.50	Copper oxides and hydroxides	1 658	5 093	1 648	4 130
2833.25	Copper sulphates	13 350	11 315	15 379	13 642
2836.99.90.10	Copper carbonates	4	9	4	10
2837.19.00.10	Copper cyanides	40	245	49	294
3212.90.00.12	Pigments based on copper or copper alloy powders and flakes	–	–	–	–
3212.90.90.12	Other, pigments based on copper or copper alloy powders and flakes	8	134	5	87
7401.10	Copper mattes	12 287	22 429	489	2 292
7401.20	Copper mattes; cement copper (precipitated copper)	9 891	17 783	1 550	5 845
7402.00	Copper anodes	27 713	71 232	11 484	23 909
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	Refined copper				
	Total	16 474	38 887	11 780	34 679
7403.21 to 7403.29	Refined copper and copper alloys, unwrought				
	Other copper alloys				
	Total	8 094	22 592	12 006	38 127
7404.00	Waste and scrap, copper or copper alloy				
	United States	68 026	110 012	85 530	155 958
	Bulgaria	972	2 188	2 994	8 239
	Chile	–	–	1 501	3 301
	Cuba	740	933	1 207	1 970
	United Kingdom	350	964	318	602
	Finland	4 057	10 884	–	–
	Other countries	684	1 240	624	868
	Total	74 829	126 221	92 174	170 938
7405.00	Master alloys of copper	181	763	294	1 255
7406.10 to 7406.20	Copper powders and flakes				
	Total	2 510	12 831	2 304	12 367

TABLE 1 (cont'd)

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7407.10 to 7407.29	Bars, rods and profiles of refined copper				
	United States	35 693	113 708	37 107	129 131
	United Kingdom	78	396	2 389	7 913
	South Korea	1 643	3 646	5 348	7 476
	Poland	2 938	5 017	3 024	6 389
	Turkey	1 122	2 455	3 001	5 953
	Other countries	1 815	6 209	2 328	7 975
	Total	43 289	131 431	53 197	164 837
7408.11 to 7408.29	Copper and copper alloy wire				
	Total	21 562	66 722	28 845	95 966
7409.11 to 7409.90, 7410.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil				
	Total	41 514	238 062	49 464	303 526
7411.10	Pipes and tubes, refined copper	8 755	37 299	10 593	48 573
7411.21	Pipes and tubes, copper-zinc base alloy	3 825	21 581	4 324	23 885
7411.22	Pipes and tubes, copper-nickel base alloy or copper-nickel-zinc base alloy	530	3 542	392	2 508
7411.29	Plates and tubes, copper alloy, n.e.s.	1 068	5 102	1 953	11 971
7412.10	Fittings, pipe or tube, of refined copper	764	10 321	923	11 305
7412.20	Fittings, pipe or tube, copper alloy	5 065	64 755	5 573	70 744
7413.00	Stranded wire, cable, plaited bands and the like, of copper, not electrically insulated	4 953	16 410	5 822	24 300
7414.20	Cloth (including endless bands), grill and netting of copper wire and expanded metal of copper	. .	184	. .	245
7414.90	Cloth, grill and netting of copper wire and expanded metal of copper	294	1 272	348	1 621
7415.10	Nails, tacks, drawing pins, staples and similar articles of copper or of iron or steel with copper heads	187	1 113	244	1 403
7415.21	Washers, copper, including spring washers	291	1 794	270	1 832
7415.29	Articles of copper, not threaded, n.e.s., similar to those of headings 7415.10 and 7415.21	498	2 838	904	4 367
7415.31	Screws, copper, for wood	61	312	39	237
7415.32	Screws, bolts and nuts of copper, excluding wood screws	. .	5 532	. .	6 267
7415.39	Articles of copper, threaded, n.e.s., similar to bolts, nuts and screws	1 042	5 633	837	4 502
7416.00	Copper springs	. .	452	. .	558
7419.10	Chain and parts thereof of copper	61	413	62	462
7419.91	Articles of copper, not further worked than cast, moulded, stamped or forged	3 252	23 329	10 754	1 366 735
7419.99	Articles of copper, n.e.s.	. .	51 294	. .	56 606
	Total Imports		1 315 720		2 946 316

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; [p] Preliminary;
[1] Anode copper recovered in Canada from domestic concentrates plus exports of payable copper in concentrate and matte.
[2] Imports from "other countries" may include re-imports from Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, COPPER PRODUCTION, TRADE[1] AND USE, 1975, 1980 AND 1985-2000

	Production		Exports				
	Shipments[2]	Refinery Output	Concentrates and Matte	Refined	Total	Imports Refined	Use[3] Refined
				(tonnes)			
1975	733 826	529 197	314 518	320 705	635 223	10 908	196 106
1980	716 363	505 238	286 076	335 022	621 098	13 466	208 590
1985	738 637	499 626	320 619	280 033	600 652	19 131	222 466
1986	698 527	493 445	341 390	306 822	648 212	20 901	225 586
1987	794 149	491 124	381 126	288 800	669 926	16 583	231 288
1988	758 478	528 723	348 404	268 680	617 084	4 659	236 280
1989	704 432	515 216	348 739	321 690	670 429	4 408	213 046
1990	771 433	515 835	374 875	335 941	710 816	2 611	180 605
1991	780 362	538 339	348 080	377 985	726 065	2 321	159 170
1992	761 694	539 302	346 842	385 761	732 603	8 916	156 132
1993	709 650	561 580	319 840	408 364	728 204	21 155	185 565
1994	590 784	549 869	237 554	388 568	626 122	19 594[r]	199 350[r]
1995	700 843	572 616	274 493[r]	434 693[r]	709 186[r]	24 176[r]	189 550[r]
1996	652 499	559 200	409 577	384 338	793 915	28 700	218 280
1997	647 779	560 582	515 547	381 476	897 023	22 602	224 777
1998	690 762	562 261	450 867	355 825	806 692	18 685	246 212
1999	581 583	548 563	290 630	294 106	584 736	16 474	266 504
2000[p]	623 451	552 200	493 226	288 335	781 561	11 780	271 981

Sources: Natural Resources Canada; Statistics Canada.

[p] Preliminary; [r] Revised.

[1] Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. [2] From 1975 to 1988, anode copper recovered in Canada from domestic concentrate plus exports of payable copper in concentrates and matte. Starting in 1989 to date, recoverable copper in concentrate shipped. [3] Producers' domestic shipments of refined copper plus imports of refined shapes.

TABLE 3. WORLD MINE PRODUCTION OF COPPER, 1998-2000

	1998	1999	2000[p]
		(000 t)	
Chile	3 687	4 391	4 602
United States	1 886	1 623	1 454
Indonesia	809	786	1 005
Australia	607	719	829
Canada	705	620	634
China	480	520	589
Peru	483	536	554
Russia	500	510	525
Poland	436	463	456
Kazakhstan	339	374	436
Mexico	385	381	365
Zambia	315	270	241
Papua New Guinea	152	188	203
South Africa	188	161	148
Other	1 761	1 640	1 141
Total	12 228	12 733	13 182

Source: International Copper Study Group.

[p] Preliminary.

TABLE 4. WORLD REFINERY PRODUCTION OF COPPER, 1998-2000

	1998	1999	2000[p]
		(000 t)	
Chile	2 335	2 666	2 668
United States	2 489	2 132	1 800
Japan	1 277	1 342	1 437
China	1 211	1 174	1 370
Russia	640	750	816
Germany	696	696	709
Canada	563	549	551
Australia	286	419	487
Poland	447	470	486
South Korea	373	450	469
Peru	411	434	452
Belgium/Luxembourg	368	388	423
Mexico	447	427	411
Kazakhstan	325	362	395
Spain	304	305	316
Scandinavia	280	263	273
Zambia	280	258	225
Brazil	167	193	185
Philippines	152	148	139
Other	1 011	1 075	1 210
Total	14 062	14 501	14 822

Source: International Copper Study Group.
p Preliminary.

TABLE 5. WORLD REFINED COPPER USE, 1998-2000

	1998	1999	2000[p]
		(000 t)	
United States	2 889	2 995	3 019
China	1 422	1 506	1 879
Japan	1 254	1 294	1 349
Germany	1 147	1 138	1 310
South Korea	566	789	861
Italy	590	635	674
Taipei, China	584	655	628
Mexico	302	412	447
Belgium/Luxembourg	345	353	348
Australia	298	290	342
Brazil	298	290	342
United Kingdom	363	300	323
Scandinavia	279	292	318
Poland	263	268	290
Spain	235	255	284
Canada	246	267	274
India	253	264	265
Russia	150	158	180
Other	1 971	2 027	2 167
Total	13 455	14 188	15 300

Source: International Copper Study Group.
p Preliminary.

TABLE 6. COPPER AND COPPER-NICKEL SMELTERS IN CANADA, 2000

Company and Location	Product	Rated Annual Capacity[1]	Feed Material	Remarks
		(000 tonnes)		
Falconbridge Limited Falconbridge, Ontario	Copper-nickel matte	23	Nickel-copper concentrates	Copper-nickel concentrate processed in fluid bed roasters and an electric furnace; 1800-t/d sulphuric acid plant treats roaster gases. Matte from the smelter is refined in Norway.
Inco Limited Sudbury, Ontario	Molten "blister" copper, nickel sulphide and nickel sinter for the company's refineries; nickel oxide sinter for market, soluble nickel oxide for market	135	Bulk nickel-copper concentrates, scrap	Oxygen flash-smelting of copper sulphide concentrate. Copper converters produce blister copper. Oxygen flash furnace for smelting of nickel-copper concentrate; converters for production of nickel-copper Bessemer matte. Production of matte followed by matte treatment, flotation, separation of copper and nickel sulphides, then by roasting to make nickel oxides for refining and marketing. Oxygen flash conversion of copper sulphide to semi-blister followed by pyrorefining to blister copper.
Falconbridge Limited Timmins, Ontario	Molten "blister" copper	125	Copper concentrates, scrap	Mitsubishi-type smelting, separation and converting furnaces. Hazelett continuous cast anodes. Incremental expansion increased capacity to 140 000 t/y in 1999.
Noranda Inc. Horne smelter Rouyn-Noranda, Quebec	Copper anodes	200	Copper concentrates, scrap	New continuous converter commissioned in 1997.
Noranda Inc. Gaspé smelter Murdochville, Quebec	Copper anodes	135	Copper concentrates	Green charge reverberatory furnace, three converters, one rotary anode furnace and an acid plant.
Hudson Bay Mining and Smelting Co., Limited (HBMS) Flin Flon, Manitoba	Copper anodes	90	Copper concentrates	Five roasting furnaces, one reverberatory furnace and two converters. Modernization planned but delayed indefinitely.

Source: Data were provided by the companies listed.

[1] Copper in matte, blister and anode.

TABLE 7. COPPER REFINERIES IN CANADA, 2000

Company and Location	Rated Annual Capacity	Remarks
	(tonnes)	
Noranda Inc. CCR Refinery Montréal-Est, Quebec	350 000	Refines anodes from Noranda's Horne and Gaspé smelters, and also from purchased scrap and anode scrap. Precious metals, selenium and tellurium are recovered from slimes. Modernization program completed in July 1999 will raise capacity to 360 000 t/y by 2001.
Inco Limited Copper Cliff, Ontario	140 000	Casts and refines anodes from molten converter copper from the Copper Cliff smelter, and also refines purchased scrap. Gold, silver, selenium and tellurium cake are recovered from anode slimes. Recovers and electrowins copper from Copper Cliff nickel refinery residue. Annual capacity is a function of copper content in concentrates produced.
Inco Limited Copper Cliff, Ontario	9 000	Electrowinning plant processes copper-bearing fluids.
Falconbridge Limited Timmins, Ontario	120 000	Refines anodes from the Kidd Creek smelter. Incremental expansion increased capacity to 147 000 t/y in 2000.
Boliden Limited McLeese Lake, British Columbia	2 000	Dissolved copper-in-solution from heap leaching operations is treated in a solvent extraction plant and then electrowinned to produce copper cathode. Production suspended in December 1998. Operation sold to Taseko Mines Limited in April 1999.

Source: Data were provided by the companies listed.

TABLE 8. U.S. SUPPLY OF WIRE MILL, BRASS MILL, FOUNDRY AND POWDER PRODUCTS, AND THEIR USE, 1999 AND 2000

United States	1999	2000p
	(000 t)	
SUPPLY		
Domestic mill products		
Building wire	645	650
Magnet wire	353	363
Telecommunications cable	295	306
Power cable	142	145
Automotive wire and cable	172	179
Electronic wire and cable	118	136
Other wire and cable	301	311
Strip, sheet, plate and foil	610	646
Rod and bar	562	566
Tube and pipe	583	567
Mechanical wire	43	45
Foundry products	174	175
Powder products	20	21
Total, domestic mill products	4 017	4 110
Imported mill products	142	222
Total supply	4 159	4 332
USES		
Building construction	1 690	1 696
Electrical/electronic products	1 093	1 196
Industrial machinery/equipment	449	458
Transportation equipment	492	497
Consumer and general products	435	485
Total	4 159	4 332

Source: Copper Development Association Inc.
p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 9. YEARLY AVERAGE COPPER PRICES,[1] 1980-2000

Year	LME
	(current US¢/lb)
1980	99.0
1981	79.0
1982	67.1
1983	72.1
1984	62.5
1985	64.3
1986	62.3
1987	80.9
1988	117.9
1989	128.9
1990	121.0
1991	106.2
1992	103.7
1993	86.8
1994	104.7
1995	132.9
1996	104.1
1997	103.2
1998	75.0
1999	71.3
2000	82.4

Source: International Copper Study Group.
[1] Grade A, Cash.

TABLE 10. MONTHLY AVERAGE COPPER PRICES, 1999 AND 2000

	LME[1]		COMEX[2]	
	1999	2000	1999	2000
	(current US¢/lb)			
January	64.9	83.6	65.1	84.8
February	64.0	81.7	63.9	82.4
March	62.5	78.9	62.5	79.6
April	66.5	76.2	67.0	77.4
May	68.6	82.8	69.1	82.8
June	64.5	79.5	65.2	80.7
July	74.4	81.6	76.0	83.9
August	74.7	84.2	75.9	86.7
September	79.4	88.9	80.9	91.5
October	78.2	86.1	79.3	87.6
November	78.4	81.4	79.1	83.2
December	80.1	83.9	81.3	86.9

Source: International Copper Study Group.
[1] LME cash price for Grade A copper. [2] COMEX First Position High Grade price.

TABLE 11. WORLD COPPER SCRAP RECOVERY AS A PERCENTAGE OF TOTAL REFINED PRODUCTION, 1997-99

	1997		1998		1999	
	(000 tonnes)	%	(000 tonnes)	%	(000 tonnes)	%
Europe	2 109	15.5	2 088	14.8	2 186	15.1
Asia	1 526	11.2	1 415	10.0	1 327	9.2
Africa	37	0.3	37	0.3	33	0.2
America	1 783	13.1	1 681	11.9	1 547	10.7
Oceana	46	0.3	45	0.3	60	0.4
Total[1]	5 501	40.5	5 266	37.2	5 153	35.6

Source: World Bureau of Metals Statistics.
[1] Final percentage calculation includes refined copper from other countries.

Diamonds

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SUMMARY

Major events in the Canadian and international diamond industry during 2000/01 included the following:

- The Diavik diamond project in the Northwest Territories received its regulatory permits allowing construction to begin at the mine site. The $1.3 billion mine is expected to begin production early in 2003.

- BHP Diamonds Inc. (now BHP-Billiton) bought Dia Met Diamonds Inc. for $687 million to consolidate its interest in the Ekati diamond mine at 80%.

- De Beers Canada Ltd. bought Winspear Diamonds Inc. in 2000 for $305 million. This gave De Beers a 67.8% interest in the Snap Lake diamond project. In early 2001, De Beers purchased the remaining 32.2% interest in the project from Aber Resources for $173 million. In August 2001, De Beers announced that it would delay production at Snap Lake by one year to 2006.

- In mid-2001, De Beers Ltd. completed its privatization process and was delisted from the Johannesburg Stock Exchange. The company is now the world's largest private diamond miner.

- In 2000, the diamond trading arm of De Beers, Diamond Trading Company (DTC), sold a record $5.67 billion worth of diamonds. The final sales figures for 2001 are expected to be down substantially as sales in the first half were down by 26% to $2.62 billion and second-half sales are usually lower than the first half.

- In Australia, the ownership of Ashton Mining and its 40% interest in the Argyle diamond mine was hotly contested by Rio Tinto and De Beers. In the end, Rio Tinto prevailed and purchased Ashton for A$713 million.

- During 2000/01, the Kimberley Process to address the conflict diamonds issue took shape and resulted in a proposed international certification scheme for rough diamonds that will be fully implemented by the end of 2002.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current of July 31, 2001. (3) More detailed information on diamonds is available on the Internet at http://www.nrcan.gc.ca/mms/cmy/CMY_E3.html and at http://www.gov.nt.ca/RWED/diamond/index.htm.

NOTE TO READERS

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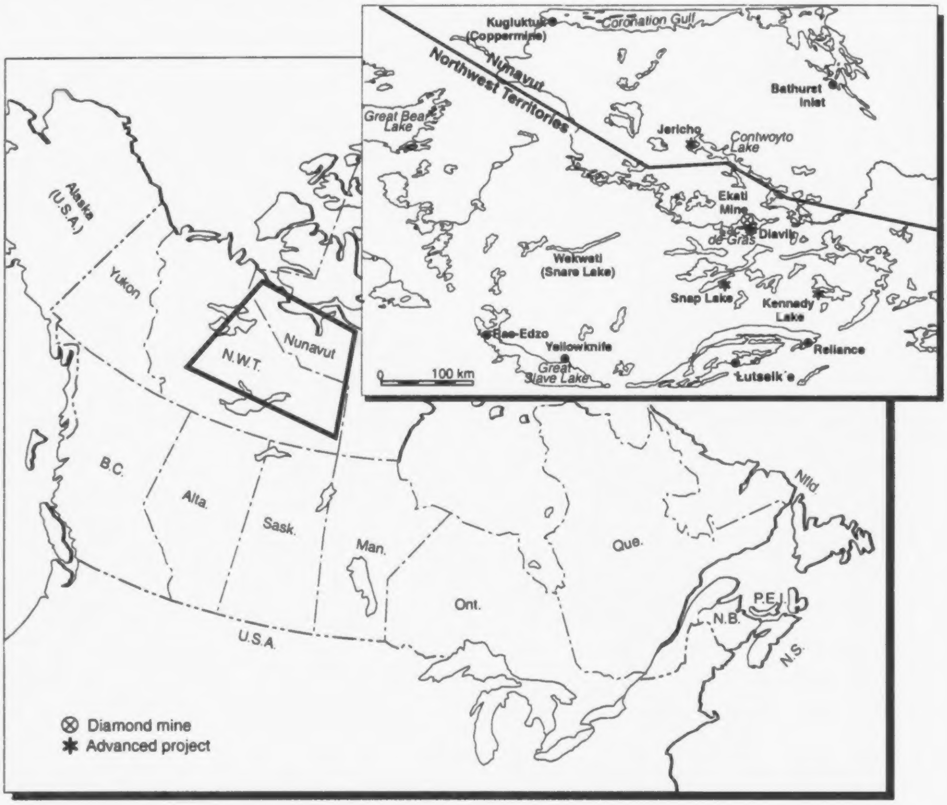
Figure 1
Diamond Properties, Slave Province


Kugluktuk (Coppermine)
Coronation Gulf
Nunavut
Northwest Territories
Great Bear Lake
Bathurst Inlet
Jericho
Contwoyto Lake
Ekati Mine
Lac de Gras
Diavik
Wekweti (Snare Lake)
Snap Lake
Kennedy Lake
Rae-Edzo
Yellowknife
Great Slave Lake
Reliance
Lutselk'e
0
100 km
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
⊗ Diamond mine
✱ Advanced project

Source: Indian and Northern Affairs Canada.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set	Free	Free	Free	Free
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted, but not mounted or set	Free	Free	Free	Free
7102.29	Diamonds, industrial, other	Free	Free	Free	Free
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted	Free	Free	Free	Free
7102.39	Diamonds, non-industrial, other	Free	Free	Free	Free
7105.10	Natural or synthetic diamond dust or powder	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, DIAMOND PRODUCTION AND TRADE, 1998-2000

Item No.		1998		1999		2000^p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
PRODUCTION							
	Northwest Territories	203 351	40 775	2 428 783	606 254	2 557 964	638 161
	Total	203 351	40 775	2 428 783	606 254	2 557 964	638 161
EXPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Belgium	. .	42 262^r	. .	523 987^r	1 404 582	364 839
	United Kingdom	–	–	. .	21 178^r	612 832	159 672
	United States	. .	175^r	. .	553^r	800	1 504
	Other countries	. .	147^r	. .	13^r	1 912	437
	Total	. .	42 584^r	. .	545 731^r	2 020 126	526 452
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted						
	United States	2 946	74	6 800^r	178^r	906	65
	Total	2 946	74	6 800^r	178^r	906	65
7102.29	Diamonds, industrial, other						
	United States	248	107	185^r	141^r	20 025	163
	Total	248	107	185^r	141^r	20 025	163
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted						
	United States	10 354	329	26 729^r	4 017^r	10 651	1 520
	Israel	–	–	–	–	41	106
	Australia	–	–	–	–	8	4
	Total	10 354	329	26 729^r	4 017^r	10 700	1 630
7102.39	Diamonds, non-industrial, other						
	United States	1 556	5 210	3 036^r	9 468^r	4 806	13 367
	Belgium	502	569	248	132	1 076	838
	Israel	339	337	–	–	304	541
	Other countries	102	182	–	–	1 055	240
	Total	2 499	6 298	3 284^r	9 600^r	7 241	14 986
7105.10	Natural or synthetic diamond dust and powder						
	United States	93 851	58	117 795^r	66^r	72 543	50
	Hong Kong	–	–	–	–	476	1
	Total	93 851	58	117 795^r	66^r	73 019	51
IMPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Israel	. .	8 169	. .	15 032^r	. .	31 690
	India	. .	13 322	. .	14 600^r	. .	15 552
	United States	. .	9 129	. .	10 665^r	. .	11 928
	Belgium	. .	8 931	. .	8 352^r	. .	9 221
	Other countries	. .	2 250	. .	4 370^r	. .	3 541
	Total	. .	41 801	. .	53 019^r	. .	71 932
7102.21.00.10	Diamonds, industrial, bort and black, diamonds for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	. .	524	. .	393	. .	663
	Belgium	. .	322	. .	525	. .	473
	United Kingdom	. .	310	. .	407	. .	305
	Ghana	. .	336	. .	229	. .	285
	Other countries	. .	120	. .	230	. .	169
	Total	. .	1 612	. .	1 784	. .	1 895
7102.21.00.90	Diamonds, industrial, other, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	31 152	229	47 495^r	244^r	73 538	603
	Belgium	52 678	374	13 761	81	13 335	99
	Ghana	3 422	30	8 657	53	7 941	46
	Ireland	2 000	9	4 592^r	30^r	3 146	35
	Japan	5 256	32	6 199	41	4 785	31
	Other countries	35 578	292	81 009	910	8 253	56
	Total	130 086	966	161 713^r	1 359^r	110 998	870
7102.29.00.10	Diamonds, industrial, other, bort and black diamonds, for borers, but not mounted or set						
	United States	1 086	181	560	97	1 226	139
	Australia	1 286	8	203	26	110	23
	India	559	175	99^r	24^r	384	14
	Other countries	7 362	140	401	106	2 621	18
	Total	10 293	504	1 263^r	253^r	4 341	194

TABLE 1 (cont'd)

Item No.		1998		1999		2000^p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.29.00.90	Diamonds, industrial, other, other than bort and black, for borers, worked but not mounted or set						
	Ireland	299 376	1 888	187 991	1 108	145 022	1 071
	Belgium	817	215	5 964	440	12 091	329
	United States	4 340	176	16 664	156	854	172
	Other countries	6 137	182	1 462^r	126^r	1 943	92
	Total	310 670	2 461	212 081^r	1 830^r	159 910	1 664
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted, not mounted or set						
	Belgium	2 769^r	1 923	3 359^r	2 380^r	4 619	3 285
	Israel	1 454	950	2 221^r	2 017^r	2 564	1 897
	United States	830	441	490^r	211^r	1 262	448
	Other countries	12 171	958	325^r	115^r	1 118	179
	Total	17 224^r	4 272	6 395^r	4 723^r	9 563	5 809
7102.39.00.10	Diamonds, non-industrial, other, of a weight not exceeding 0.5 carats each						
	Israel	31 027	21 860	40 778^r	37 451^r	39 732	35 753
	Belgium	16 662^r	14 951^r	11 691^r	13 787^r	15 535	14 283
	United States	7 998^r	6 966^r	13 584^r	9 226^r	15 822	10 707
	India	9 347	3 172	6 181^r	2 821^r	7 460	3 368
	Other countries	1 737	1 015	1 514^r	1 069^r	1 176	1 442
	Total	66 771^r	47 964^r	73 748^r	64 354^r	79 725	65 553
7102.39.00.20	Diamonds, non-industrial, other, of a weight exceeding 0.5 carats each						
	Belgium	53 346	44 633^r	72 753^r	60 602^r	80 631	62 016
	Israel	44 161	55 344	44 756^r	41 749^r	48 122	46 786
	United States	16 655	20 825	22 828^r	24 596^r	44 929	34 192
	India	66 205	23 686	86 253^r	29 634^r	75 912	30 405
	Other countries	3 102	2 266	7 201^r	6 224^r	10 956	12 875
	Total	183 469	146 754^r	233 791^r	162 805^r	260 550	186 274
7105.10.00.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	551 697	1 610	348 188^r	885^r	421 276	1 036
	Ireland	18 378	76	27 601	114	59 719	126
	Ghana	16 497	47	11 056	38	10 842	38
	Other countries	24 629	66	18 284	56	11 711	37
	Total	611 201	1 799	405 129^r	1 093^r	503 548	1 237
7105.10.00.91	Natural diamond dust and powder						
	United States	113 444	331	102 805	324	150 451	447
	Belgium	–	–	1 917	7	20 552	72
	Other countries	40 412	92	102 360	243	11 539	40
	Total	153 856	423	207 082	574	182 542	559
7105.10.00.92	Synthetic diamond dust or powder						
	Ireland	387 965	1 172	817 749	2 438	1 530 223	3 868
	United States	1 058 437	1 034	990 403	1 397	1 224 678	2 414
	Belgium	–	–	9 219	24	189 673	306
	Other countries	134 790	329	103 618	170	128 639	183
	Total	1 581 192	2 535	1 920 989	4 029	3 073 213	6 771

Sources: Statistics Canada; Natural Resources Canada.
– Nil; . . Not available; ^{p} Preliminary; ^{r} Revised.
Note: Numbers may not add to totals due to rounding.

Gypsum and Anhydrite

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GYPSUM

Canadian shipments of natural gypsum totaled 8.5 Mt valued at $95.9 million in 2000, based on preliminary data (Table 1). This amount compares to 9.3 Mt valued at $106.6 million in 1999, based on final data. The reported 8.5% decrease in shipments resulted mainly from a decrease in demand for finished products in both the United States and Canada, according to preliminary data from Statistics Canada and to the Gypsum Association. In addition to shipments of natural gypsum, domestic shipments of commercial-quality, flue-gas derived (FGD) gypsum from coal-fired generating stations are estimated to be about 400 000 t/y, with total use estimated to be 550 000 t/y.

Canadian Industry

Most gypsum producers in Canada are closely integrated in both mining and wallboard manufacturing. Six companies operate eleven mines and a total of fourteen wallboard plants accounting for an estimated 2000 employees. The major gypsum mining and related production plants are listed in Table 2.

In Atlantic Canada, Nova Scotia accounts for nearly 80% of Canada's output of natural gypsum and nearly all of its exports. Most gypsum deposits being mined in the Atlantic provinces are characterized by their high quality, amenability to inexpensive mining methods, and close access to coastal bulk-shipping facilities.

In Newfoundland, Lafarge Canada Inc. completed a modernization program at its wallboard manufacturing plant that it purchased in 1999 from affiliates of Atlantic Group Limited.

Georgia-Pacific Canada Inc., operating in Nova Scotia, received approval to develop new reserves of gypsum near Melford in Cape Breton to eventually replace its current operation in this region.

In New Brunswick, Plaster Rock Gypsum and Manufacturing Company, located in Plaster Rock, began crushing gypsum with a view to supplying agricultural markets in 2001.

In Quebec, most demand for gypsum is satisfied by shipments of raw material, including synthetic gypsum from Atlantic Canada.

In Ontario and western Canada, developments remained essentially the same. (Refer to the "Gypsum and Anhydrite" chapter of the 1998 *Canadian Minerals Yearbook*.)

World Developments and Trade

World reserves of gypsum are widespread; North American reserves are estimated to be more than 1.1 billion t. World production of gypsum in 2000 was an estimated 110 Mt, based mainly on estimates by the U.S. Geological Survey (refer to the Office of Minerals Information's web site at http://www.usgs.gov). The United States ranked number one with production of 25 Mt, followed by Iran, 9.7 Mt; China, 9.0 Mt; and Canada, 8.5 Mt. Shipments of wallboard by U.S. producers were 2.6 billion m^2, based on estimates made in late 2000 by the Washington, D.C.-based Gypsum Association (GA). (This amount represents more than a 3% decrease in shipments compared to the previous 12-month period.)

Canada's imports of gypsum from the United States and Mexico (Table 1) are used by both wallboard and cement manufacturers. Imports from Spain, however, are reportedly for use only by specific cement manufacturers.

In the United States, the construction of several major new plants and expansions designed to use only synthetic gypsum continued during 2000.

Processing and Markets

In North America, wallboard manufacturing accounts for an estimated 75% of gypsum use, cement processing accounts for 10-15%, and agriculture and industrial processes account for the remainder. In general, the wallboard industry serves the residential, institutional and commercial building sectors. In the United States, more than 6 Mt/y of synthetic gypsum is reported as being sold or used as a complete or partial substitute for natural gypsum, according to the U.S. Geological Survey. U.S. shipments of wallboard in 2000 were at near-full capacity, amounting to more than 2.9 billion m^2 (31.6 billion square feet), a record for the industry according to the GA (Canadian wallboard plants produced about 281 million m^2 [3.0 billion square feet], also according to the GA).

The Portland cement industry requires crushed, non-calcined gypsum, acting as a set regulator in a proportion up to 5% by total weight, ground with the primary stage cement clinker, to produce the final cement product. Based on this proportion of gypsum, the total amount required by cement producers in Canada is estimated to be 400 000-450 000 t/y.

Other uses for gypsum relate mainly to agriculture as a soil conditioner, as a mineral filler in joint compounds, plastics and paints, and in certain glass-making technologies.

Process Research ORTECH Inc. sponsored Gypsum 2000 – Sixth International Conference on Natural and Synthetic Gypsum, held in Toronto in May. This series of conferences has contributed greatly to improving communication and the dissemination of new information among power utilities and other synthetic gypsum producers, users, and equipment suppliers. It is expected that the seventh conference will be held again in Toronto in 2002.

Prices

Prices for gypsum in merchant markets are negotiated among buyers and sellers, and published figures are not always relevant. In Canada, the average reported value for crude gypsum, f.o.b. mine, is about $11.10/t for the five-year period from 1996 to 2000.

Outlook

Canadian shipments of gypsum in 2001 are expected to be moderately weaker based on projected weaker exports serving residential and non-residential construction markets in the United States. In Canada, housing starts were 137 000 in 1998, 150 000 in 1999, and about 152 000 in 2000; starts in 2001 are forecast to be about 155 000, according to the Canada Mortgage and Housing Corporation. Domestic demand for gypsum remains positive, based on continuing overall economic growth and an increase in the value of building permits in early 2001. Also, the outlook continues to be positive in the commercial and institutional building sectors, and commercial vacancy rates are relatively low in several urban areas in Canada. This suggests that additional real estate space will be needed in the near future.

Diverse uses of gypsum related to building plasters, Portland cement, fillers and pigments, soil conditioners, and fertilizers as a diluent are important and tend to expand with overall economic growth. The present structure of the industry in Canada is not expected to change significantly, although the future availability of low-cost synthetic gypsum resulting from more strenuous emission controls may serve to increase demand for this mineral.

ANHYDRITE

Production and trade statistics for anhydrite are included with gypsum. Anhydrite, the anhydrous form of gypsum (about twice as hard and also denser than gypsum), is produced by Fundy Gypsum Company at Wentworth, Nova Scotia, and by Little Narrows Gypsum Company at Little Narrows, Nova Scotia.

Shipments of anhydrite in 1999 were 163 300 t, mainly to the United States for use as a peanut crop fertilizer, and to Quebec and Ontario for final-stage processing of Portland cement. Similarly, shipments in 2000 were an estimated 191 000 t, according to the Nova Scotia Department of Natural Resources.

Test work on the use of anhydrite in floor screed and suspended floor systems, comprising part of an earlier Canada-Nova Scotia cooperative mineral development project, showed promise as new uses for Canadian gypsum. Similarly, testing of anhydrite (in combination with water and special chemicals) as a mine "pack" construction material to improve underground support in coal mines has been encouraging.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of January 30, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2520.10	Gypsum; anhydrite	Free	Free	Free	Free
2520.20	Plasters	Free	Free	Free	Free
68.09	Articles of plaster or of compositions based on plaster: Boards, sheets, panels, tiles and similar articles, not ornamented				
6809.11	Faced or reinforced with paper or paperboard only				
6809.11.10	Gypsum wallboard	6%	Free	Free	Free
6809.11.90	Other	6%	Free	Free	Free
6809.19.00	Other	6.5%	3%	Free	Free
6809.90	Other articles				
6809.90.10	Models and casts, of a kind used in the manufacture of dental prosthesis	Free	Free	Free	Free
6809.90.90	Other	6.5%	3%	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, GYPSUM PRODUCTION AND TRADE, 1998-2000

Item No.		1998		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)							
	Crude gypsum						
	Newfoundland	x	x	x	x	x	x
	Nova Scotia	6 545 537	72 857	7 483 604	83 637	6 876 446	75 746
	Ontario	x	x	x	x	x	x
	Manitoba	x	x	x	x	x	x
	British Columbia	x	x	x	x	x	x
	Total[1]	8 306 534	94 349	9 345 342	106 634	8 548 139	95 853
IMPORTS							
2520.10	Gypsum, anhydrite						
	United States	82 405	5 269	83 336	9 220	78 864	10 239
	Mexico	14 084	1 681	37 514	2 353	75 673	1 763
	United Kingdom	–	–	83	122	30	16
	Brazil	–	–	89	127	–	–
	Other countries	104	39	26	21	19	26
	Total	96 593	6 989	121 048	11 843	154 586	12 044
2520.20	Gypsum; anhydrite; plasters						
	United States	38 216r	12 343r	28 609	9 619	36 199	11 205
	Japan	60	43	73	64	122	106
	Italy	91r	68r	77	45	132	82
	Germany	8	9	31	24	51	46
	Mexico	7	2	30	8	113	21
	Other countries	126	70	126	73	98	47
	Total	38 508r	12 535r	28 946	9 833	36 715	11 507
		(square metres)		(square metres)		(square metres)	
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	. .	3 039	. .	5 152	. .	7 487
	United Kingdom	. .	108	. .	1 988	. .	35
	Germany	–	–	. .	1 897	. .	1
	Poland	–	–	. .	1 931	–	–
	Other countries	. .	4	. .	10	. .	60
	Total	. .	3 151	. .	10 978	. .	7 583
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	6 622	. .	9 469	. .	10 788
	Other countries	. .	77	. .	33	. .	50
	Total	. .	6 699	. .	9 502	. .	10 838
6809.90	Articles of plaster or compositions based on plaster						
	United States	. .	4 252	. .	4 293	. .	3 522
	Mexico	. .	814	. .	557	. .	1 531
	China	. .	683	. .	448	. .	558
	United Kingdom	. .	672	. .	601	. .	507
	Thailand	. .	68r	. .	21	. .	72
	Germany	. .	118	. .	7	. .	5
	Other countries	. .	143	. .	140	. .	120
	Total	. .	6 750r	. .	6 067	. .	6 315
	Total imports of gypsum and gypsum products	. .	36 124r	. .	48 223	. .	48 287

TABLE 1 (cont'd)

Item No.		1998		1999		2000^{p}	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2520.10	Gypsum, anhydrite						
	United States	5 530 117	70 726	6 224 766	88 343	6 321 232	97 427
	Japan	–	–	–	–	171	11
	Denmark	22 029	477	–	–	–	–
	Other countries	. . .	. . .	64	18	64	3
	Total	5 552 146	71 203	6 224 830	88 361	6 321 467	97 441
2520.20	Gypsum; anhydrite; plasters						
	United States	1 444	1 184	1 791	946	765	651
	France	23	11	–	–	99	73
	Bermuda	40	27	21	14	74	45
	Other countries	23	21	23	13	69	39
	Total	1 530	1 243	1 835	973	1 007	808
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard	**(square metres)**		**(square metres)**		**(square metres)**	
	United States	102 086 319	225 314	134 337 396	300 984	73 254 228	129 152
	Trinidad and Tobago	29 405	85	10 600	33	32 658	81
	Saudi Arabia	–	–	–	–	26 155	65
	Hong Kong	–	–	–	–	26 042	50
	Portugal	10 600	27	10 400	26	19 000	48
	Hungary	–	–	–	–	12 122	47
	China	–	–	7 900	20	17 200	43
	Germany	–	–	11 400	28	14 900	37
	Cuba	48 100	121	150 092	353	12 680	32
	Bermuda	40 230	107	3 109	12	10 300	26
	Croatia	–	–	12 400	31	5 400	14
	India	–	–	–	–	4 950	12
	Latvia	–	–	–	–	4 672	8
	Saint Pierre and Miquelon	3 600	9	14 352	24	8 767	6
	Chile	17 500	44	10 600	27	513	4
	Barbados	73 501	118	43 700	110	–	–
	Netherlands Antilles	3 982	10	42 160	106	–	–
	Venezuela	–	–	42 100	106	–	–
	Saint Kitts and Nevis	–	–	33 200	84	–	–
	Australia	–	–	24 300	67	–	–
	Saint Lucia	–	–	12 200	31	–	–
	United Kingdom	–	–	11 664	29	–	–
	Japan	–	–	11 100	28	–	–
	Czech Republic	–	–	9 600	24	–	–
	New Zealand	–	–	9 807	17	–	–
	South Korea	–	–	5 206	13	–	–
	Namibia	–	–	4 170	10	–	–
	Saint Vincent and the Grenadines	–	–	1 920	5	–	–
	Guyana	–	–	1 543	4	–	–
	France	43 332	130	–	–	–	–
	Israel	33 084	70	–	–	–	–
	Russia	18 809	42	–	–	–	–
	Total	102 408 462	226 077	134 820 919	302 172	73 449 587	129 625
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	21 338	. .	39 230	. .	28 110
	Chile	. .	57	. .	168	. .	269
	Cuba	–	–	–	–	. .	119
	Italy	. .	162	–	–	–	–
	Other countries	. .	128	. .	124	. .	71
	Total	. .	21 685	. .	39 522	. .	28 569
6809.90	Articles of plaster or compositions based on plaster						
	United States	. .	20 190	. .	29 572	. .	29 759
	Finland	–	–	. .	110	. .	115
	United Kingdom	–	–	. .	79	. .	62
	United Arab Emirates	–	–	. .	360	. .	22
	Bahamas	. .	443	. .	432	–	–
	Israel	. .	198	–	–	–	–
	China	. .	126	–	–	–	–
	Other countries	. .	386	. .	239	. .	136
	Total	. .	21 343	. .	30 792	. .	30 094
	Total exports of gypsum and gypsum products	. .	341 551	. .	461 820	. .	286 537

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; ^{p} Preliminary; ^{r} Revised; x Confidential.

[1] Totals do not include gypsum produced or shipped for use by Canadian Portland cement producers.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GYPSUM MINING AND GYPSUM PRODUCTS MANUFACTURING OPERATIONS, 2000

Company	Location	Operation
NEWFOUNDLAND		
Lafarge Gypsum Canada Inc.	Fischells Brook	Open-pit mining
	Corner Brook	Wallboard manufacture
NOVA SCOTIA		
CGC Inc.	Port Hawkesbury	Fibre-gypsum board manufacture
Fundy Gypsum Company	Wentworth and Miller Creek	Open-pit mining of gypsum and anhydrite
Georgia-Pacific Corporation	Sugar Camp	Open-pit mining
Little Narrows Gypsum Company	Little Narrows	Open pit mining of gypsum and anhydrite
National Gypsum (Canada) Ltd.	Milford	Open-pit mining
NEW BRUNSWICK		
Westroc Inc.	McAdam	Wallboard manufacture
QUEBEC		
CGC Inc.	Montréal	Wallboard manufacture
	Saint-Jérôme	Wallboard plant mothballed
Georgia-Pacific Corporation	Montréal	Distribution terminal only
Westroc Inc.	Montréal	Wallboard manufacture
ONTARIO		
CGC Inc.	Hagersville	Underground mining and wallboard manufacture
Georgia-Pacific Corporation	Caledonia	Underground mining and wallboard manufacture
Westroc Inc.	Clarkson	Wallboard manufacture
MANITOBA		
Georgia-Pacific Corporation	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
Westroc Inc.	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
ALBERTA		
Georgia-Pacific Corporation	Edmonton	Wallboard manufacture
Westroc Inc.	Calgary	Wallboard manufacture
BRITISH COLUMBIA		
Georgia-Pacific Corporation	Canal Flats	Open-pit mining
	Vancouver	Gypsum products manufacture
Westroc Inc.	Vancouver	Gypsum products manufacture
	Windermere	Open-pit mining

Source: Natural Resources Canada.

TABLE 3. CANADA, GYPSUM PRODUCED, TRADED AND USED, 1975, 1980 AND 1985-2000

	Production[1]	Imports[2]	Exports	Apparent Use[3]
		(tonnes)		
1975	5 719 451	553 338	3 691 676	2 581 113
1980	7 336 000	154 717	4 960 240	2 530 477
1985	7 760 783	121 802	5 879 664	2 002 921
1986	8 802 805	221 644	5 921 982	3 102 467
1987	9 093 926	217 625	5 704 853	3 606 698
1988[a]	8 813 760	274 917	5 651 286	3 437 391
1989	8 179 588	291 373	5 357 055	3 113 906
1990	7 977 685	318 114	5 757 327	2 538 472
1991	6 727 221	259 863	4 940 193	2 046 891
1992	7 294 700	260 505	5 010 649	2 544 556
1993	7 563 369	280 581	5 315 618	2 528 332
1994	8 587 303	292 156	5 942 572	2 936 887
1995	8 054 741	177 327	5 565 427	2 666 641
1996	8 201 774	247 208	5 526 010	2 922 972
1997	8 627 772	220 914	5 981 974	2 866 712
1998	8 306 534	96 593	5 552 146	2 850 981
1999	9 345 342	121 048	6 224 830	3 241 560
2000[p]	8 548 139	154 586	6 321 467	2 381 258

Sources: Natural Resources Canada; Statistics Canada.

[p] Preliminary.

[a] Beginning in 1988, imports and exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS class 2520.10.00 (gypsum, anhydrite).

[1] Producers' shipments of crude gypsum. [2] Includes crude and ground, but not calcined. [3] Production plus imports minus exports.

TABLE 4. CANADA, VALUE OF CONSTRUCTION BY TYPE, 1996-2000

	1996	1997	1998	1999	2000
			($ millions)		
BUILDING CONSTRUCTION					
Residential investment	32.3	36.5	36.0	38.8	40.8
Non-residential building investment	19.6	22.5	22.4	24.2	25.3
Total building construction	51.9	59.0	58.4	63.0	66.1
ENGINEERING CONSTRUCTION					
Mining and oil and gas extraction	13.9	18.2	16.7	15.4	19.3
Transportation and warehousing	2.0	2.2	5.0	5.0	4.1
Other engineering	15.2	14.7	14.5	16.6	18.3
Total engineering construction	31.1	35.1	36.2	37.0	41.7
Total components	83.0	94.1	94.6	100.0	107.8

Sources: Natural Resources Canada; Statistics Canada, CANSIM II (Table 026-0013 – Residential Values, by Type of Investment and Related Table 031-0002 – Flows and Stocks of Fixed Non-Residential Capital, by North American Industry Classification System). (More information can be obtained on the Internet at the CANSIM II site at http://www.statcan.ca/english/CANSIM.)
Notes: Numbers may not add to totals due to rounding. Expenditures include value of new construction and major renovation work purchased.

TABLE 5. WORLD PRODUCTION OF GYPSUM, 1999 AND 2000

Country	1999	2000^e
	(000 tonnes)	
Canada	9 345	8 500
Australia	2 100	2 100
China	9 000	9 000
France	4 500	4 500
India	2 200	2 200
Iran	9 750	9 750
Japan	5 500	5 500
Mexico	7 000	7 000
Spain	7 500	7 500
Thailand	5 000	5 000
United Kingdom	1 800	1 800
United States	22 400	25 000
Other countries	20 780	20 800
Total world	106 875	108 650

Sources: Natural Resources Canada; U.S. Geological Survey, January 2001.
^{e} Estimated.

Iron Ore

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CANADIAN DEVELOPMENTS

Since the closure in 1998 of the Algoma Iron Ore Division near Wawa, Ontario, nearly all of Canada's iron ore production has been concentrated in the Labrador Trough, a major geological belt extending through northern Quebec and Labrador. Canada's production in this area comes from three mining operations owned by Iron Ore Company of Canada (IOC), Quebec Cartier Mining Company (QCM), and Wabush Mines. The remaining production comes from the by-product recovery of magnetite from two base-metal smelters in British Columbia.

In 2000, on account of strong demand from the steel industry, especially for pellets, Canada's iron ore production reached 35.7 Mt, an increase of 5.1% compared to the previous year. In line with this increase, the value of Canada's production grew by 9.6% to $1.54 billion. However, despite this strong showing, Canada's iron ore exports fell by 0.56% to just over 26.3 Mt because of weakening demand starting in September. The pellet market remained strong with a 9.3% increase in exports, but concentrate exports declined 17.6% over the year. The drastic fall in demand for concentrate was brought about by the hike in the price for natural gas, used for pelletization, and by the onset of an economic slowdown.

In August 2000, Rio Tinto Ltd. completed the acquisition of North Ltd. of Australia and the latter's 56.1% controlling interest in IOC. The remaining ownership is split with Mitsubishi Corp. owning 25% and the Labrador Iron Ore Royalty Income Fund owning 18.9%. Upon completion of the transaction, Rio Tinto sanctioned the refurbishment and reactivation of its pellet plant in Sept-Îles, Quebec, which had been announced earlier in the year by IOC. This plant had been mothballed in 1982 when the Schefferville operation was closed. Commissioning of the $361.5 million project, scheduled for June 2002, will result in the addition of 4.5 Mt/y of capacity to the company's pellet production and will provide 140 permanent jobs.

INTERNATIONAL DEVELOPMENTS

According to the UNCTAD Trust Fund Project for Iron Ore Information, following a slowdown in both 1998 and 1999, world iron ore production increased by 8.0% in 2000 to reach 937.8 Mt,[1] the highest production level ever reached by the industry. Countries registering the highest incremental increases were Ukraine (16.7%), South Africa (14.2%) and Mexico (13.4%).

Likewise, world exports increased 10.7% to 487.8 Mt in 2000 from the 440.6 Mt reached in 1999. Australia maintained its position as the world's number one iron ore exporting country with exports totaling 165.2 Mt in 2000, closely followed, as usual, by Brazil with 160.1 Mt. Countries that benefited the most from this increased trade were Sweden (15.1%), Brazil (14.2%), and Australia and the former Soviet Union (13.0% each).

Variations observed in the import market are even more important than in the export market with total imports reaching 485.3 Mt in 2000, a 12.1% increase from the previous year. The strongest growth in 2000, observed in Asia, indicates that the region's economies appear to have started bouncing back following the financial crisis experienced in the area in the late 1990s. Japan remains the world's largest importer of iron ore (131.7 Mt), followed by China (70.0 Mt), Germany (47.5 Mt) and South Korea (39.0 Mt). However, China, with an increase of 26.6% in 2000 over the previous year, and Germany, with an increase of 22.1% – two countries involved in large infrastructure development programs – appear to be the leading forces of the growth.

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[1] This figure includes the application of a conversion factor to China's low-grade natural iron ore production so that the latter's % Fe content is about equal, on average, to that in the rest of the world.

PRICES

On the strength of market demand for iron ore in the first quarter of the year, when prices are established for the year, iron ore producers negotiated significant price increases that compensated for the price drop incurred in 1999. Prices for Canadian products jumped by 5.15% and 4.34% for concentrate bound for Europe and Japan respectively, and by 7.32% for pellets bound for Europe. Despite lower exports, these price increases helped maintain the value of Canada's exports, which rose by 0.1% to about $1053 million.

OUTLOOK

The consolidation and restructuring of the global iron ore industry witnessed in 2000 should continue during the coming years to enable producers to improve their competitiveness through economies of scale. This will help the iron ore and steel industry preserve its market share as a supplier of low-cost, versatile, high-performance material of choice for use in a variety of applications.

Any change in the economic situation in Asia is expected to have a marked impact on steel markets and, consequently, on iron ore use. China, one of the fastest-growing economies in the world, is expected to continue to look to foreign suppliers to satisfy a large part of its iron ore requirements. Chinese imports of iron ore rose from 14.3 Mt in 1990 to over 70 Mt in 2000, representing an annual growth rate of over 17%. The development of a more modern market economy in China and the demand for higher-quality products are expected to lead that country to maintain or increase its present level of imports.

The reduction in iron ore shipments from Canada in the second half of 2000, on a year-to-year basis, indicates a slowdown in the industry that may result in Canadian shipments of iron ore dropping significantly in 2001, possibly to around 30 Mt.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of January 1, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not included as a reference, guide or suggestion to be used in trading, investment or other commercial activities. The author and Natural Resources make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. CANADA, IRON ORE PRODUCTION AND TRADE, 1999 AND 2000

Item No.		1999		2000p	
		(tonnes)[1]	($000)	(tonnes)[1]	($000)
PRODUCTION (mine shipments)					
	By province				
	Newfoundland	18 943 897	863 111	21 091 517	976 432
	Quebec	14 962 334	x	14 516 000	x
	British Columbia	83 749	x	99 072	x
	Total[2]	33 989 980	1 406 296	35 706 589	1 540 837
IMPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	United States	33 059	886	55 738	1 410
	United Kingdom	–	–	15 440	386
	Canada	5	. . .	155	5
	Germany	16	. . .	141	4
	Mexico	. .	. . .	103	4
	France	–	–	60	2
	South Africa	2	. . .	34	1
	China	. .	. . .	14	1
	Tanzania	14	. . .	4	. . .
	Guinea	–	–	2	. . .
	India	4	. . .	2	. . .
	Spain	–	–	3	. . .
	Turkey	–	–	8	. . .
	Uganda	–	–	1	. . .
	Gabon	–	–	1	. . .
	Hong Kong	–	–	2	. . .
	Indonesia	–	–	2	. . .
	Japan	–	–	9	. . .
	Sweden	3	. . .	–	–
	Russia	1	. . .	–	–
	Brazil	469	19	–	–
	Nicaragua	1	. . .	–	–
	Total	33 574	905	71 719	1 813
2601.12	Iron ore, agglomerated				
	United States	6 679 241	342 850	6 344 821	347 946
	Brazil	135 472	4 852	86 693	6 654
	Venezuela	55 523	3 403	62 726	3 255
	United Kingdom	–	–	71	4
	Taiwan	–	–	24	1
	Chile	3	. . .	–	–
	Australia	16	1	–	–
	Total	6 870 255	351 106	6 494 335	357 860
EXPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	Germany	2 493 340	65 830	2 539 276	68 301
	United Kingdom	2 137 941	54 860	1 711 708	40 913
	France	1 859 653	41 731	1 106 050	26 008
	Netherlands	1 171 019	33 691	691 443	19 535
	Japan	811 817	19 813	685 376	17 902
	United States	623 245	18 501	485 902	14 236
	South Korea	465 824	11 666	372 999	9 215
	China	146 600	3 669	235 197	6 401
	Philippines	–	–	168 293	4 499
	Total	9 709 439	249 761	7 996 244	207 010
2601.12	Iron ore, agglomerated				
	United States	6 240 221	287 908	7 504 883	340 019
	Germany	1 221 678	54 619	2 557 430	122 014
	Italy	1 990 667	99 174	2 149 678	102 031
	United Kingdom	2 290 053	111 758	1 665 538	76 717
	Netherlands	1 551 615	79 794	1 053 277	51 595
	Australia	674 609	35 717	736 003	35 340
	Belgium	1 031 039	50 184	563 296	26 889
	China	422 569	21 800	448 015	21 567
	France	733 678	32 587	464 548	21 159
	Turkey	–	–	299 030	11 326
	Taiwan	480 410	22 574	248 963	10 820
	Portugal	130 854	6 318	151 622	7 241
	Japan	–	–	149 135	7 204
	Philippines	–	–	164 591	4 510
	Malaysia	–	–	99 985	4 147
	South Korea	–	–	75 001	3 701
	Total	16 767 393	802 433	18 330 995	846 280

TABLE 1 (cont'd)

Item No.	1999		2000^p	
	(tonnes)[1]	($000)	(tonnes)[1]	($000)
EXPORTS (cont'd)				
Total exports, all classes				
United States	6 863 466	306 409	7 990 785	354 255
Germany	3 715 018	120 449	5 096 706	190 315
United Kingdom	4 427 994	166 618	3 377 246	117 630
Italy	1 990 667	99 174	2 149 678	102 031
Netherlands	2 722 634	113 485	1 744 720	71 130
France	2 593 331	74 318	1 570 598	47 167
Australia	674 609	35 717	736 003	35 340
China	569 169	25 469	683 212	27 968
Belgium	1 031 039	50 184	563 296	26 889
Japan	811 817	19 813	834 511	25 106
South Korea	465 824	11 666	448 000	12 916
Turkey	–	–	299 030	11 326
Taiwan	480 410	22 574	248 963	10 820
Philippines	–	–	332 884	9 009
Portugal	130 854	6 318	151 622	7 241
Malaysia	–	–	99 985	4 147
Total	26 476 832	1 052 194	26 327 239	1 053 290

Sources: Natural Resources Canada; Statistics Canada; American Iron Ore Institute.
– Nil; . . Not available; . . . Amount too small to be expressed; ^{p} Preliminary; ^{r} Revised; x Confidential.
[1] Dry tonnes for production (shipments) by province or territory; natural weight for imports and exports. [2] Total iron ore shipments include shipments of by-product iron ore.

TABLE 2. CANADA, IRON ORE SHIPMENTS, 1995-2000

Company and Location	Ore Mined	Product Shipped	1995	1996	1997	1998	1999	2000^p
			(000 tonnes, natural or wet)					
Algoma Ore Division Algoma Steel Inc. Wawa, Ontario	Siderite	Sinter[1]	997	733	795	651	–	–
Iron Ore Company of Canada Schefferville, Quebec	Hematite, goethite and limonite	Direct shipping	–	–	–	–	–	–
Carol Lake, Labrador	Specular hematite and magnetite	Concentrate	4 634	4 038	4 678	5 172	3 983	3 955
		Acid pellets	3 121	2 430	. .	. .	2 408	. .
		Fluxed pellets	7 084	8 075	11 372	12 248	3 190	11 466
		Limestone pellets	. .	. .	. .	. .	3 870	. .
		Direct reduced pellets	. .	. .	. .	. .	211	. .
		Chips	188	169	. .	. .	. .	. .
Loadstone Limited Newfoundland	Magnetite	Concentrate	–	300	100	–	–	–
Quebec Cartier Mining Company Mount Wright, Quebec	Specular hematite	Concentrate	7 759	7 264	7 159	6 757^r	6 304	6 613
		Acid pellets	4 884	2 521	3 795	3 577^r	2 820	. .
		Self-fluxed pellets	3 449	5 481	4 324	2 824^r	3 036	8 234
		Low-Si pellets	–	51	225	1 638^r	1 591	. .
		Low-Si self-fluxed pellets	–	–	–	103	1 045	. .
Wabush Mines Wabush, Labrador and Pointe-Noire, Quebec	Specular hematite and magnetite	Acid pellets	3 322	3 155	3 440^r	3 127^r	3 445	6 014
		Fluxed pellets	1 866	2 158	2 257^r	2 518^r	2 046	. .
		Concentrate	135	–	. .	. .	. .	. .
		Chips	105	24	. .	. .	. .	. .
British Columbia producers	Magnetite	Concentrate	83	88	100	102	92^r	102
Total			37 627	36 486	38 245	38 717	34 041^r	35 934

Source: Natural Resources Canada.
– Nil; . . Not available; ^{p} Preliminary; ^{r} Revised.
[1] Includes about 400 000 t of iron-bearing material not from the mine.

TABLE 3. RECEIPTS, USE AND INVENTORIES OF IRON ORE AT CANADIAN IRON AND STEEL PLANTS, 1999 AND 2000

	1999	2000
	(000 tonnes)	
Receipts imported	7 249	6 850
Receipts from domestic sources	7 359	6 468
Total receipts at iron and steel plants	14 608	13 318
Use of iron ore	13 782	14 042
Inventory at docks, plants, mines and furnace yards, December 31	8 353	8 818
Inventory change	1 615	465

Source: American Iron Ore Association.

TABLE 4. WORLD IRON ORE PRODUCTION, 1998-2000

	1998	1999	2000
		(000 tonnes, natural)	
China	97 100	92 200	96 100
Brazil	183 000	188 700	200 400
Australia	161 100	162 700	176 300
Russia	72 300	81 900	87 000
India	71 700	70 200	75 000
United States	62 900	57 800	63 000
Ukraine	51 100	47 100	55 000
Canada	38 700	34 000	35 900
South Africa	33 000	29 500	33 700
Sweden	20 900	18 900	20 600
Venezuela	17 200	17 000	17 400
Mauritania	11 400	10 400	11 500
Kazakhstan	8 700	9 100	15 000
Other countries	49 400	48 900	50 900
Total	878 500	868 400	937 800

Sources: Natural Resources Canada; Interfax; UNCTAD Trust Fund Project on Iron Ore Information.

TABLE 5. SELECTED PRICES OF IRON ORE DESTINED FOR JAPAN AND EUROPE, SELECTED YEARS, 1986-2000

Ore	Market	Source	1986	1988	1990	1992	1994	1996	1998	1999	2000
			(US¢/Fe Unit Dmt, f.o.b.)								
Fines (including concentrate)	Europe	CVRD	26.26	23.50	30.80	33.10	26.47	30.00	31.00	27.59	28.79
		Iscor	22.70	20.55	24.75	. .	20.60	23.10	24.01	22.19	. .
		Kiruna	27.90	26.00	35.70	36.50	28.10	32.70	34.10	29.55	31.83
		Carol Lake	26.50	23.69	31.78	33.15	26.15	30.00	30.90	27.20	28.60
		Mt. Wright	26.50	23.69	31.78	33.15	26.15	30.00	30.90	27.20	28.60
	Japan	CVRD	23.29	20.90	27.38	28.11	22.65	25.89	26.89	23.99	25.01
		Iscor	20.23	17.75	23.62	23.86	19.21	21.55	20.65	19.93	20.80
		Hamersley[2]	25.56	23.31	30.54	31.35	25.26	28.33	29.45	26.21	27.35
		Carol Lake	22.09	19.93	26.11	27.26	21.96	24.63	25.60	22.79	23.78
Lump	Europe	Iscor	26.70	22.34	33.00	32.29	28.00	32.13	32.13	30.50	. .
		Hamersley[1]	36.20	36.00	49.97	48.28	40.28	46.82	47.94	40.75	45.56
	Japan	CVRD	23.29	21.89	29.22	29.00	24.38	27.63	28.44	25.54	27.02
		Iscor	23.53	21.86	30.21	29.79	25.74	30.02	30.91	27.76	29.36
		Hamersley[2]	29.81	27.88	38.53	38.23	32.74	37.09	38.18	34.28	36.26
Pellets	Europe	CVRD	35.60	40.35	51.60	48.47	43.64	52.40	53.56	46.46	49.24
		Kiruna	38.15	46.35	59.00	53.48	45.60	55.80	57.20	48.70	53.00
		Carol Lake	36.50	39.95	52.58	49.35	44.00	53.80	54.88	47.15	50.60
		Mt. Wright	36.50	39.95	52.58	49.35	44.00	53.80	54.88	47.15	50.60
	Japan	CVRD (Nibrasco)	34.73	37.93	48.50	45.57	41.03	49.26	50.34	43.68	46.29
		Savage River	35.45	35.89	45.90	43.12	38.83	46.62	47.65	41.33	43.80

Sources: *The Tex Report*; *Skillings Mining Review*; UNCTAD.

. . Not available; Dmt Dry metric tonne; f.o.b. Free on board.

[1] c.i.f. Rotterdam; [2] f.o.b. Dampier.

Note: Price is reported in cents, U.S. currency, for each percentage point of iron in a tonne of ore, e.g., at 30¢/Fe unit, ore grading 65% iron would bear a price of 65 x 30¢ = US$19.50/t.

Lead

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According to preliminary figures from the International Lead and Zinc Study Group (ILZSG), the use of lead worldwide rose to a record level of 6.5 Mt in 2000, an increase of 3.5% over 1999. Although world mine production of lead decreased by 0.7% to 2.9 Mt from 1999, lead metal production rose by 4.7% to 6.6 Mt. Overall, there was a close balance between total supply and demand in the Western World, with the Western World shortfall made up from imports from former Eastern countries.

The decline in reported user stocks during 2000 was complemented by a decline in producer and London Metal Exchange (LME) lead stocks. The net result was a year-on-year decline in total stocks of 45 000 t in 2000. LME stocks stood at 131 000 t at the end of the year.

CANADIAN DEVELOPMENTS

Canada's mine production of lead declined for the second consecutive year, reaching 148 769 t in 2000 compared to 162 180 t in 1999. Lower-than-expected output at Myra Falls in British Columbia and temporary problems at the Brunswick mine in New Brunswick contributed to the lower output in Canada in 2000 (Figure 2).

Canadian lead metal production was 283 763 t in 2000, compared to 266 415 t in 1999. Lead production from recycled materials has grown in its share of total production and accounted for 124 571 t, or approximately 44% of total Canadian lead metal output in 2000 (Figure 3).

British Columbia

Rock stability problems at Cominco Ltd.'s Sullivan mine that had started at the end of 1999 continued to result in lower concentrate production in early 2000. Improvements at the mine during the first quarter, however, resulted in higher zinc and lead concentrate production. The mine is expected to continue to operate until the planned closure date in December 2001. In December 2000, Cominco announced that it would reduce metal production at its Trail smelter through to January 2001 as the result of a power swap agreement with a major U.S. energy company.

Yukon

Work continued throughout the year on the Finlayson project in southeastern Yukon Territory. Expatriate Resources Ltd. created the Finlayson project by consolidating its interests in its wholly owned mineral lands, its interest in the Wolverine Joint Venture (60% Expatriate, 40% Atna Resources Ltd.) and its mineral lands acquired from Cominco Ltd. In March, Expatriate announced the acquisition of Cominco's interest in the Kudz Ze Kayah deposit and surrounding mineral lands. With the acquisition of Kudz Ze Kayah, the emphasis of the prefeasibility study shifted to co-development of the Finlayson project. In November, Expatriate and Atna completed a prefeasibility study indicating that the Finlayson project is technically and economically viable.

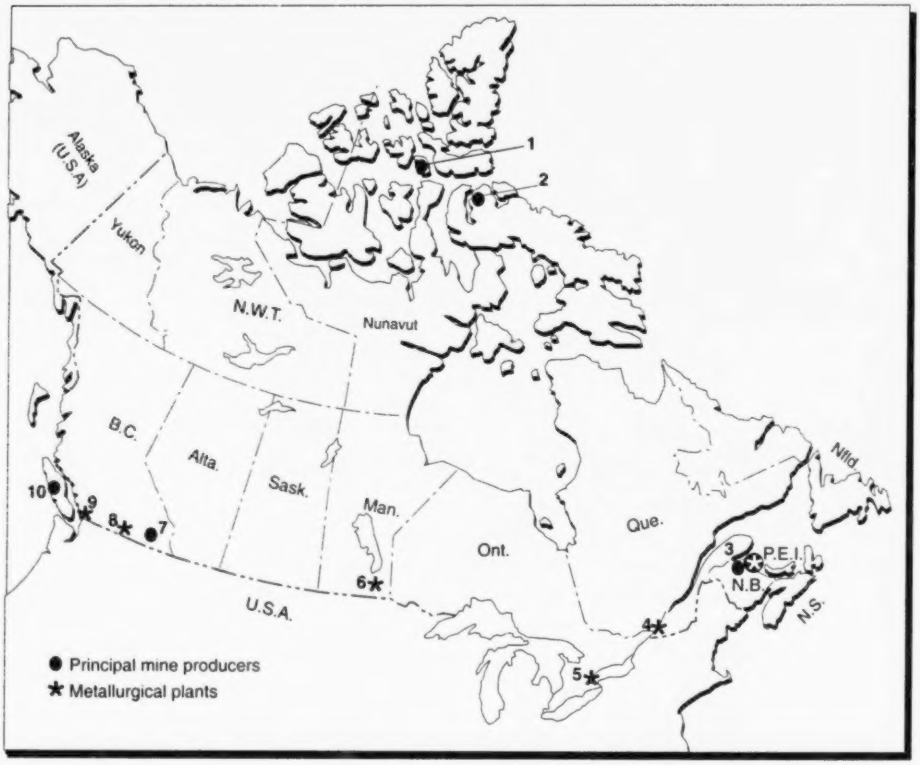
Ontario

Exide Technologies announced that it will re-open and upgrade its battery manufacturing plant in Maple, Ontario. Exide plans to produce industrial-type lead-acid batteries at the plant for the growing motive power and telecommunications markets. One type of battery to be produced at the Maple plant is used as a back-up power source for Internet and wireless-driven voice, data and multimedia networks. Exide closed the Maple plant, originally used to manufacture automotive-type lead-acid batteries, after its acquisition of GNB Technologies, Inc. in September 2000. Initial production was expected in April 2001 with full production in October 2001.

New Brunswick

Breakwater Resources Ltd.'s Caribou mine has remained on care and maintenance since August 1998. Based on pilot plant testing, a plan to restart the mine was completed in the first quarter of 1999.

Figure 1
Lead Producers in Canada, 2000


Alaska (U.S.A)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
9
10
● Principal mine producers
★ Metallurgical plants

Numbers refer to locations on map above.

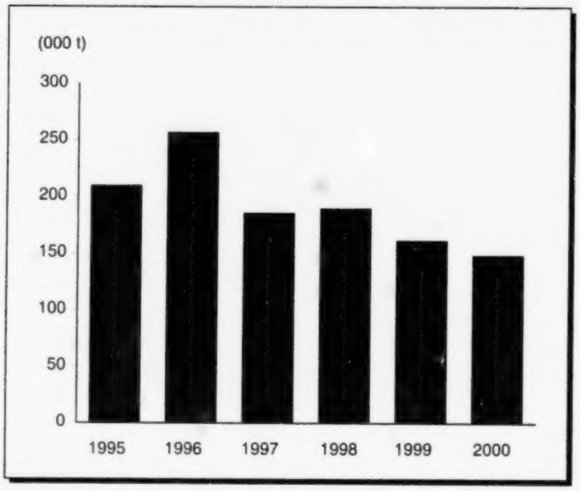
LEAD-PRODUCING MINES

1. Polaris, Cominco Ltd.
2. Nanisivik, Breakwater Resources Ltd.
3. Brunswick, Noranda Inc.
7. Sullivan, Cominco Ltd.
10. Myra Falls, Boliden Limited

LEAD METALLURGICAL PLANTS

3. Belledune, Noranda Inc.
4. Nova Pb Inc., General Smelting Company of Canada, and American Iron and Metal Co. (1999) Inc.
5. Tonolli, Tonolli Canada Ltd. and Canada Metal Company
6. The Canada Metal (Western) Ltd.
8. Trail, Cominco Ltd.
9. Metalex Products Ltd.

Figure 2
Canadian Mine Production of Lead, 1995-2000



Source: Natural Resources Canada.

The plan indicated that the flotation capacity of the mill will have to be expanded by about 40% in order to achieve the desired metallurgical results. The capital cost to restart the mine is approximately $12 million, excluding working capital. A decision to re-open the mine still awaits higher metal prices.

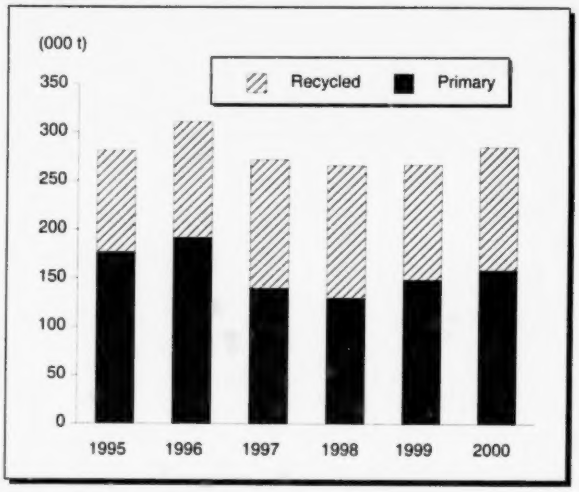
Noranda Inc. ratified new three-year collective agreements with unionized employees at the Brunswick smelter in Belledune, New Brunswick. In 1999, the Brunswick bulk concentrate facility handled some 360 000 t of zinc and lead concentrate. The lead smelter produced more than 100 000 t of lead and custom alloys.

WORLD DEVELOPMENTS

According to ILZSG data, world mine production of lead continued its downward trend for the third consecutive year to reach 2.958 Mt in 2000, down from 2.979 Mt in 1999. New mine capacity for 2000 totaling some 9000 t/y was more than offset by the closure of Western Metals Limited's 45 000-t/y Hellyer mine in Australia. In terms of production, cutbacks in the United States and lower-than-expected output in Canada and Poland were largely offset by higher production in Australia, Ireland and Mexico (Figure 4).

World lead metal production increased by 4.5% to 6.6 Mt in 2000 (Figure 5). Major expansions at Korea Zinc Co. Ltd.'s Onsan plant and a slight increase at Shadian in China were offset by closure of the Shenyang plant in China. Overall, Western World primary smelter capacity increased by 55 000 t in 2000. Six new lead recycling facilities were opened in 2000, adding some 124 000 t of new capacity. The largest increase was 70 000 t/y at Pulua Indah in Malaysia, which replaced an older facility at Selayang. Closures totaled 35 000 t in 2000 for a net overall gain in recycled lead smelter capacity of 89 000 t. Just over 60% of the total Western World output was produced from recycled material, mainly in the form of lead-acid batteries.

Figure 3
Canadian Refined Lead Metal Production, 1995-2000



Source: Natural Resources Canada.

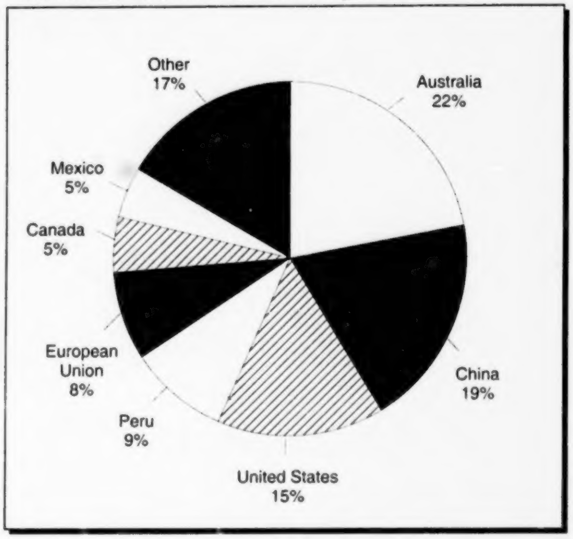
Asia/Oceania

Malaysia's Metal Reclamation (Industries) Sdn Bhd commissioned its new recycled lead smelter near Kuala Lumpur in September. The Pulua Indah smelter, which uses the MIM Isasmelt technology, has a production capacity of 70 000 t/y. The new plant will boost the company's total production capacity to 110 000 t/y.

The Jiyuan Gold smelter in Henan Province, China, started a 50 000-t/y lead expansion project that is expected to be completed by the end of 2001. Commercial production is officially scheduled to begin in early 2002. Its total production capacity of refined lead will reach 120 000 t/y once the project is complete. Elsewhere in China, the 70 000-t/y Shenyang primary lead smelter in Liaoning Province was declared bankrupt in August.

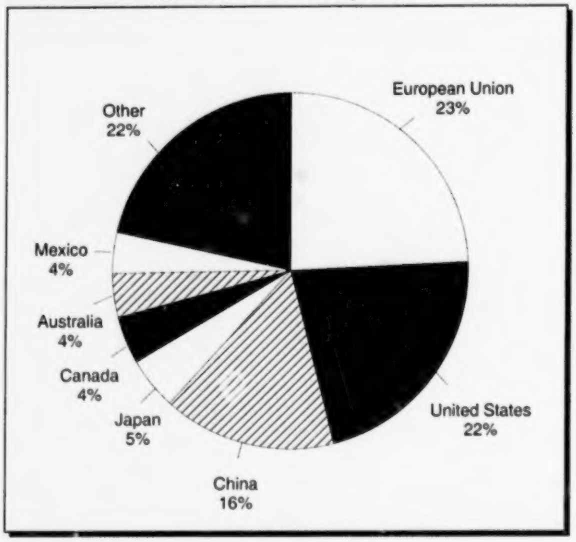
Also in August, Exide Industries Ltd. announced plans to establish an Rs120 million automotive battery unit in Bangladesh to produce around 100 000 batteries per year.

Figure 4
World Lead Mine Production, 2000



Source: International Lead and Zinc Study Group.

Figure 5
World Lead Metal Production, 2000



Source: International Lead and Zinc Study Group.

United States

In September, Cominco announced that it will rebuild and re-open the Pend Oreille zinc-lead mine near Metaline Falls, Washington. Cominco began the US$70 million project with a two-year construction program in October that involves refurbishment of the concentrator and the sinking of an internal shaft. The mine is scheduled to begin production in September 2002 at a rate of 84 000 t/y of zinc concentrates and 13 000 t/y of lead concentrates. The concentrates will be shipped to its nearby Trail smelter in southern British Columbia.

The Doe Run Company announced in mid-April that it would implement further production cutbacks at its lead facilities in Missouri. Together with the cutbacks announced by the company in January, its production of lead in concentrate was reduced by about 50 000 t.

U.S. battery manufacturer and lead recycling company Exide Corporation acquired GNB Technologies, Inc., the global battery business of Pacific Dunlop Limited, for US$368 million and renamed the combined companies Exide Technologies. GNB supplied about 20% of the North American market for industrial batteries and was also a maker of lead-acid automotive batteries.

Latin Amercia

Industrias Peñoles S.A de C.V. opened the US$39 million Rey de Plata mine in Tehuixtla, Guerrero, Mexico in October. A joint-venture project between Peñoles (51%), Dowa Mining Co. Ltd. (39%) and Sumitomo Corporation (10%), the mine will produce some 5000 t/y of lead in concentrates.

In Peru, Sociedad Minera El Brocal S.A. upgraded the treatment capacity of its concentrator at the Colquijirca mine near Cerro de Pasco for an increase in capacity of 4000 t/y.

Europe

The Lisheen mine was officially opened in June in Ireland. An equal joint-venture project between Toronto-based Ivernia West Inc. and Anglo American plc, the Lisheen mine, located near Thurles, County Tipperary, is the fifth largest zinc-lead mine in the world. It is expected to produce 4.83 Mt of zinc and lead concentrates during its 14-year lifespan. Full production is expected by mid-year 2001. At full production, Lisheen will process 1.5 Mt/y of ore and produce some 25 000 t/y of contained lead in concentrates.

Eco-Bat Technologies PLC agreed to purchase Exide Technologies' Gast recycled lead smelter in Pont-Sainte-Maxence, France. In addition to the purchase, a new furnace was installed, increasing the production capacity to 35 000 t/y, up from 25 000 t/y.

Africa

Breakwater Resources signed a letter of intent with Algeria's natural resource agency, the Office National de la Recherche Géologique et Minière (ORGM). The letter entitles Breakwater to earn up to a 90% interest in the Oued Amizour lead-zinc deposit with a total resource estimated at 30.2 Mt grading 5.5% zinc and 1.4% lead. Under the agreement, Breakwater must complete a feasibility study, arrange financing, and construct and bring the project into production. ORGM will retain a 10% net profit interest in the project once Breakwater recovers its full capital investment. Breakwater will pay ORGM US$5 million for the property from the net profits of the operation over a five-year period beginning in the first year of production.

Australia

Noranda announced in December that it had decided to exercise its option to acquire a 75% stake in the Lady Loretta project for $17 million from Buka Minerals Limited. The project is located some 140 km northwest of Mt. Isa in Queensland. Noranda's drilling program increased the estimated mineral resource from an estimated 8.3 Mt grading 18.4% zinc, 8.3% lead and 125 g/t silver to 13.6 Mt grading 17.1% zinc, 5.9% lead and 97 g/t silver.

The new Century mine, owned and operated by Pasminco Limited, was officially opened in April. The A$100 million project was completed under budget and ahead of schedule; it comprises a mine, located at Lawn Hill, and a port and dewatering facility at Karumba in Queensland. The mine and port are connected by a 304-km underground pipeline that pumps zinc and lead concentrate from the mine site to the port. The first shipment of lead concentrate was made in August and was expected to reach a rate of 40 000 t/y by year-end. By the end of 2001, the mine will have an annual capacity of 5 Mt of ore yielding 888 000 t of zinc concentrate and 70 000 t of lead concentrate.

The McArthur River zinc-lead-silver mine achieved record production of 30 000 t of lead in concentrate in 2000. The mine is a joint-venture project between M.I.M. Holdings Limited (M.I.M.) of Australia (70%) and ANT Minerals Pty. Ltd., a consortium of Japanese companies (30%) comprising Nippon Mining & Metals Co. Ltd. and Toyoha Mines Co. Ltd. M.I.M. also commissioned the George Fisher zinc-lead-silver mine at Mt. Isa in October. Average annual production is planned to be 100 000 t of lead. Ore from the George Fisher mine is hoisted through the former Hilton mine.

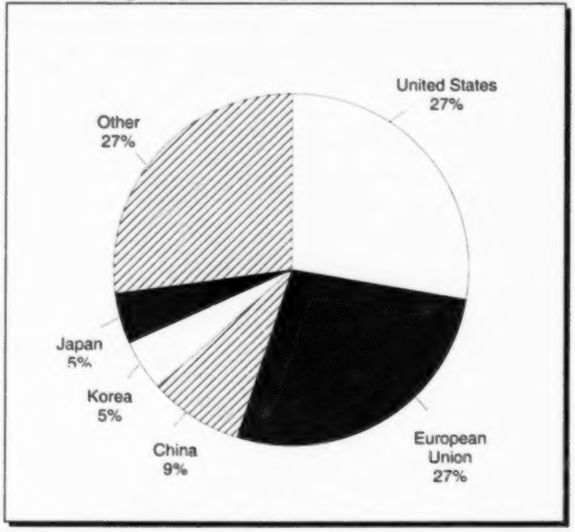
LEAD USAGE

Lead is a dense, bluish-white metal whose physical and chemical properties find application in a variety of uses in the manufacturing, construction and chemical industries. Preliminary statistics from the ILZSG indicate total world lead demand grew 3.4% from 6.3 Mt in 1999 to just under 6.5 Mt in 2000. Western World demand increased 2.8% to 5.6 Mt in 2000. Europe and the United States accounted for 32% and 28%, respectively, of world lead demand while China accounted for another 9% (Figure 6).

Lead-acid batteries constitute the largest market for lead, representing about 75% of total Western World usage. In the United States, battery manufacturing constitutes about 80% of total lead demand. The largest market for batteries, representing about 80% of lead used in the industry, is the automotive sector. The average automobile battery contains about 10 kg of lead. Some factors that influence lead demand in the automotive sector are new vehicle production, trends and age in vehicle population, and climatic conditions. For example, hotter summers and colder winters in North America and Europe during the last few years have contributed to a greater number of battery failures and increased replacement battery demand (Figure 7).

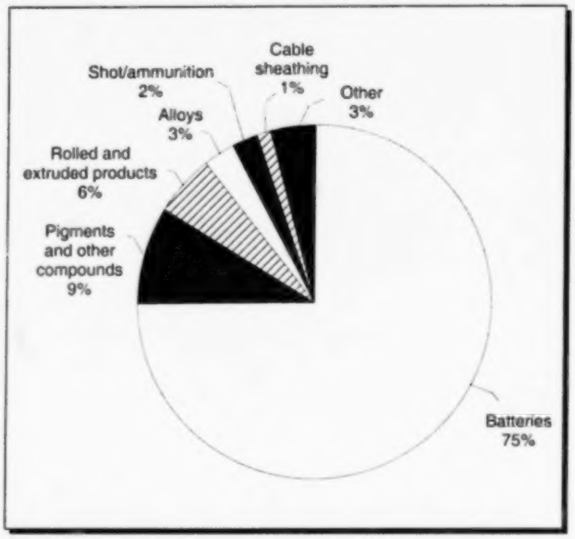
One potential growth area for the lead-acid battery is in energy storage facilities for utilities. A series of batteries are charged during low-use periods of the day and are then used to supplement existing generators during the peak morning and evening hours without drawing on other energy sources or building new power plants. In addition, the growth in cellular telephone networks has increased the demand for lead-acid batteries for stand-by power applications in the telecommunications industry.

Figure 6
Lead Usage, by Country, 2000



Source: International Lead and Zinc Study Group.

Figure 7
Western World Lead Markets, 1999



Source: International Lead and Zinc Study Group.

Electric cars may prove to be the largest new use for lead-acid batteries in the future. Since 1990, California and some other U.S. states have introduced stringent automobile emission standards that would require a certain percentage of new vehicles to be zero-emission vehicles (ZEVs), such as electric-powered vehicles.

In order to meet consumer demand for increased electrical options and advanced features, automakers are now faced with having to upgrade their vehicles' electrical systems. Automakers are in the process of switching from the traditional 12-volt electrical system to a 42-volt system with a 36-volt battery that will take loads off the engine, making it more fuel-efficient. To maintain costs, automotive manufacturers are looking at a new system that is a valve-regulated lead-acid (VRLA) battery. VRLA batteries are widely used in a number of applications and, while other battery chemistries like lithium and nickel metal hydride offer more power and less weight, lead-acid batteries have cost and recycling advantages.

The second largest use of lead is in pigments and compounds, which accounted for 8.9% of Western World demand in 1999. The principal uses are in PVC stabilizers, which prevent degradation during processing or from ultraviolet radiation; in colour pigments; and in the manufacture of glass, including crystal, light bulbs, insulators and television/computer screens. While lead is still used for some specific paint applications, its general use in this application has declined significantly due to the potential risk involved in exposure to weathered or flaked paint.

Until the mid-1970s, the production of lead additives for gasoline, including tetraethyl lead, constituted one of the most important markets for the metal. However, with the adoption of environmental regulations that have either prohibited or severely restricted the use of such additives, the demand for lead in this application has declined dramatically. In Canada, lead as an additive in gasoline for general consumption was eliminated through legislation at the end of 1990.

Lead is alloyed with tin in the production of solder used in both the electronics and plumbing sectors. In the plumbing industry, the demand for lead has decreased primarily as a result of the increasing use of plastic piping. While metal systems are still used for potable water systems, new regulations that have been adopted or are being considered will reduce or eliminate the use of lead in solder. In the electronics field, the move to miniaturization has also reduced the demand for lead in solder. Some companies are developing alternatives to lead-based solders.

Other important applications of both lead metal and lead alloys include: the production of free machining steel and brass, rolled sheet and strip for roofing applications, power and communication cable sheathing, especially for underground or submarine environments, and as a sound barrier material in construction.

Lead's high resistance to gamma radiation and X rays makes it the preferred metal for shielding around X-ray equipment and at nuclear installations.

Potential new uses for lead include: nuclear waste disposal applications; liquid metal (magnetohydrodynamics), a method of generating electricity by passing an electrically conducting fluid through a magnetic field; additives to extend the life of asphalt; barriers or shields against radon gas and electromagnetic fields; and as a damper to protect buildings from vibrations during earthquakes.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

The International Lead and Zinc Study Group was formed in 1959 to improve market information and to provide opportunities for regular inter-governmental consultations on issues related to lead and zinc markets. Particular attention is given to providing regular and frequent information on supply, demand, and the outlook for lead and zinc.

The Study Group is headquartered in London, England. In 2000, 28 countries, representing most of the world's major lead- and zinc-producing and using nations, were members of the Group. The Group has an extensive information-gathering and dissemination role and acts as an effective mechanism for increasing market transparency related to lead and zinc production, trade and use. The Group is also an important forum for communication among governments, among industry and between governments and industry. It holds a general session each year in October. Member countries' delegations include industry representatives as advisors. Canada has been an active member of the Group since its inception.

The 45th Session of the Study Group, chaired by Mr. Alek Ignatow of Canada, was held in London, England, in October 2000 and was attended by some 250 registered participants, including representatives of 26 member countries and observers from several invited nations, industry and non-governmental organizations. Delegates elected a new Secretary General, Mr. Don Smale of Australia, to replace Mr. Francis Labro of France, who retired as Secretary General at the end of the year. The next annual meeting of the Group will take place October 16-18, 2001, in New Delhi, India.

The Group continued to work on updating its capacity to deliver, through electronic means, its monthly statistical bulletin. It is expected that the bulletin will be available to member countries and subscribers through the Group's web site by mid-2001.

More information about the Group's activities and the availability of a wide range of publications pertaining to lead and zinc can be obtained from its web site at www.ilzsg.org. For information on the Group's activities in partnership with the International Copper Study Group and the International Nickel Study Group related to the contribution nonferrous metals make to sustainable development and the Consultative Forum, visit their joint web site at www.nfmsd.org.

HEALTH, SAFETY AND THE ENVIRONMENT

The Danish Environment and Energy Minister recently signed an executive order that will make Denmark the first country in the world to impose a wide-ranging ban on the use of lead. The ban is to become effective in March 2001. It will affect the use of lead and lead compounds in the construction and electronics industries as well as their use as a stabilizer in plastics and their use in ballasts and weights. Applications where there is no alternative to lead, such as in lead-acid batteries, currently are exempt from the ban. The action taken by Denmark had been opposed by 12 of the 15 European Union (EU) member states and the European Commission (EC). The objections raised by the EU states and the EC were supported in a decision by the EC's Scientific Committee on Toxicology, Ecotoxicology and the Environment in mid-2000. In that decision, the committee concluded that the Danish plan to ban lead for health reasons was scientifically unjustified.

PRICES AND STOCKS

The LME cash settlement price for lead maintained a downward trend, mirroring the steady rise in stocks through the first half of the year, falling from a peak of US$493/t in January to a low of US$399/t in April, the lowest price for the year. As prices fell, cuts in mine production, aggressive buying by China and reduced availability of scrap quickly turned a balanced market into deficit. To meet consumer demand, stocks began to follow a steady decline in late May and early June from a peak of just under 209 000 t. As a result, prices began to recover and reached a peak of US$518.50/t in late September. The recovery, however, came to an abrupt end in early October when a large volume of hidden stocks suddenly made an appearance, rising by 57 000 t to 157 000 t in a matter of one week. Prices subsequently fell back to finish the year at US$471/t. Overall, settlement prices averaged US$454.22/t for the year while three-month prices averaged $468.07/t. LME stocks ended the year at 130 650 t, down 44 950 t from the start of the year (Figures 8 and 9).

OUTLOOK

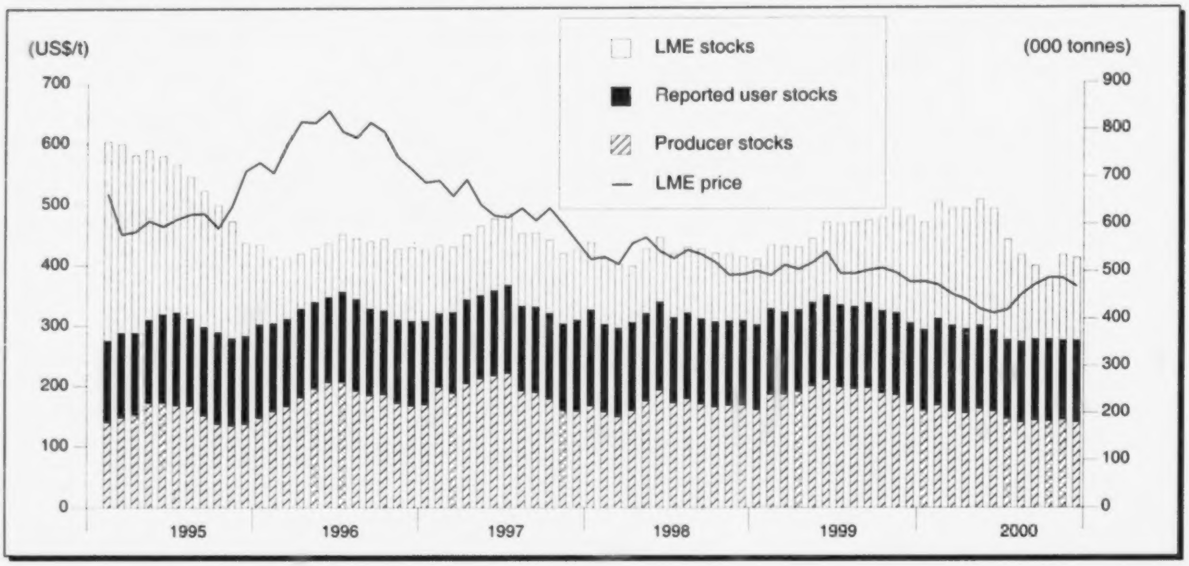
For 2001, the lead market, according to information gathered by the member countries of ILZSG, is expected to result in a deficit of about 59 000 t. A forecast rise of 2.9% is expected to result in global lead mine output of 3.03 Mt, the first time mine output will exceed 3 Mt. Western World mine production is expected to rise 2.2% to 2.27 Mt. The world supply of refined lead metal is forecast to increase by 0.9% to 6.64 Mt in 2001. Western World production, however, will fall by 0.2% to 5.06 Mt. Cash prices are expected to average between US$480 and US$490/t in 2001. In the longer term, prices are expected to average between US$500 and US$550/t to the year 2005 (Figures 10 and 11).

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of July 16, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

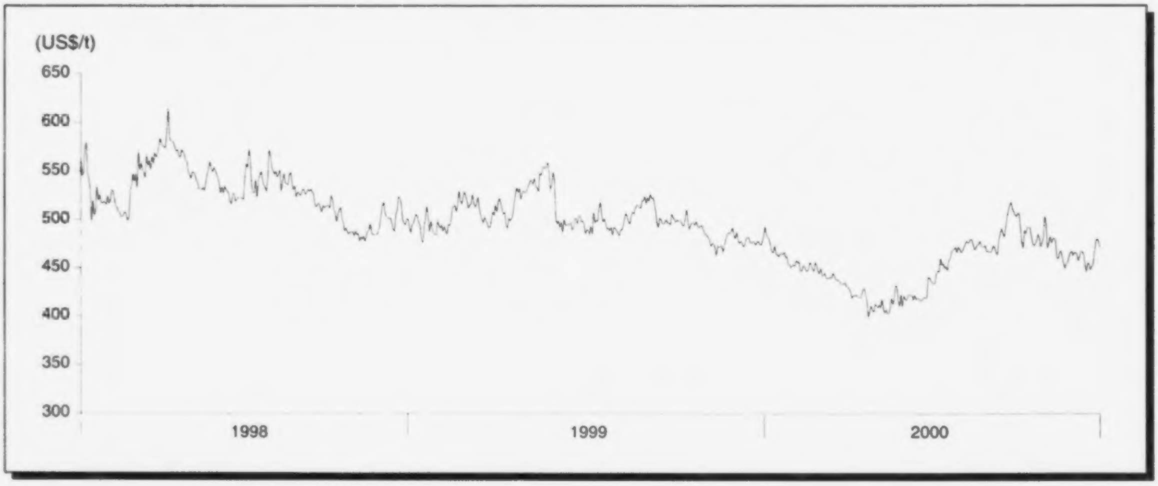
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 8
LME Monthly Average Settlement Prices and Total Stocks, 1995-2000



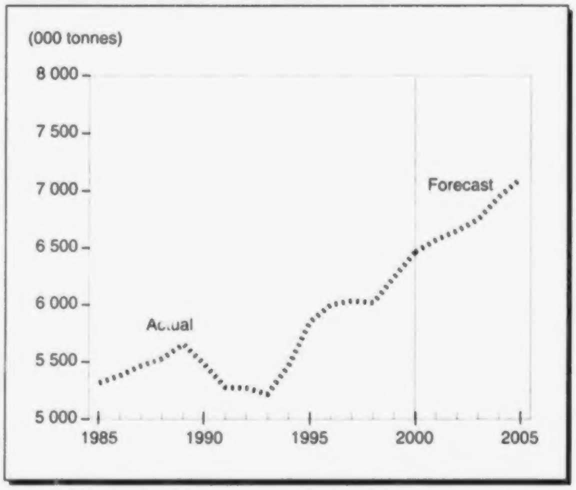
Source: International Lead and Zinc Study Group.

Figure 9
LME Daily Official Cash Settlement Prices, 1998-2000



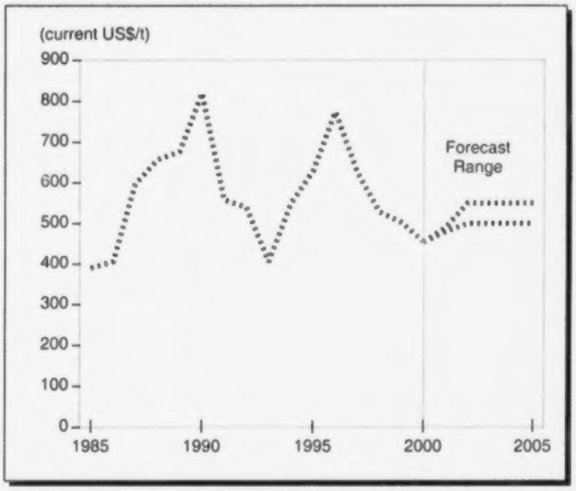
Source: London Metal Exchange.

Figure 10
World Lead Use, 1985-2005



Source: International Lead and Zinc Study Group.

Figure 11
Average Cash Settlement Lead Prices, 1985-2005
Annual LME Settlement



Source: Natural Resources Canada.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada[1]	EU MFN	Japan[1] WTO
2607.00	Lead ores and concentrates	Free	Free	Free	Free	Free	Free
78.01	Unwrought lead						
7801.10	Refined lead						
7801.10.10	Pig and block	Free	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.10.90	Other	2.5%	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.91	Other: Containing by weight antimony as the principal other element	Free	Free	Free	Free	2.5%	Free to 3% or 3.10 yen/kg, whichever is greater
7801.99.10	Lead bullion	2.5%	Free	Free	Free	Free	3% or 4.50 yen/kg, whichever is greater
7801.99.20	Lead alloys	2.5%	Free	Free	Free	2.5%	Free to 2.70 yen/kg
7801.99.90	Other	2.5%	Free	Free	Free	2.5%	3% or 4.50 yen/kg, or whichever is greater
7802.00	Lead waste and scrap	Free	Free	Free	Free	Free	2.1%
7803.00	Lead bars, rods, profiles and wire						
7803.00.10	Bars and rods, not alloyed	2.5%	Free	Free	Free	5%	3%
7803.00.90	Other	3%	Free	Free	Free	5%	3%
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) not exceeding 0.2 mm						
7804.11.10	Of lead-tin alloys, whether or not containing antimony	Free	Free	Free	Free	5%	3%
7804.11.90	Other	3%	Free	Free	Free	5%	3%
7804.19	Other						
7804.19.10	Not alloyed, of a thickness exceeding 0.2 mm but not exceeding 5 mm, and a width exceeding 600 mm	2.5%	Free	Free	Free	5%	3%
7804.19.20	Of lead-antimony-tin alloys	2.5%	Free	Free	Free	5%	3%
7804.19.90	Other	2.5%	Free	Free	Free	5%	3%
7804.20	Powders and flakes						
7804.20.10	Powders, not alloyed	2.5%	Free	Free	Free	Free	3%
7804.20.20	Alloyed powders; flakes	2.5%	Free	Free	Free	Free	3%
7805.00	Lead tubes, pipes, and tube or pipe fittings	3%	Free	Free	Free	5%	3%
7806.00	Other articles of lead	3%	Free	Free	Free	Free to 5%	3%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (40th Annual Edition: 2000); *Customs Tariff Schedules of Japan*, 2000.

[1] WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, LEAD PRODUCTION AND TRADE, 1999 AND 2000, AND USE, 1998 AND 1999

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	New Brunswick	71 978	53 696	66 570	44 602
	British Columbia	40 278	30 048	44 596	29 880
	Nunavut	43 112	32 162	31 883	21 361
	Total	155 369	115 905	143 049	95 843
	Mine output[2]	162 180	. .	152 765	. .
	Refined production				
	Primary	148 526	. .	158 133	. .
	Recycled	117 889	. .	124 719	. .
	Total	266 415	. .	282 852	. .
EXPORTS					
2603.00.20	Lead content of copper ores and concentrates	–	–	1 000	269
2607.00	Lead ores and concentrates				
	Sweden	33 786	25 062	23 786	17 224
	Germany	2 262	1 686	8 842	6 470
	China	2 166	370	3 691	1 141
	Belgium	4 016	2 995	1 355	1 011
	Italy	1 383	1 032	–	–
	Other countries	4 971	3 708	–	–
	Total	48 584	34 853	37 674	25 846
2607.00.20	Lead content of lead ores and concentrates	48 581	34 722	37 674	25 846
2608.00.20	Lead content of zinc ores and concentrates	10 250	3 574	12 227	3 761
2616.10.20	Lead content of silver ores and concentrates	–	–	–	–
7801.10	Refined lead, unwrought				
	United States	131 793	113 842	146 223	122 216
	Spain	1 203	902	602	420
	Japan	39	56	199	266
	Germany	519	391	120	83
	Other countries	4 943	3 722	–	–
	Total	138 497	118 913	147 144	122 985
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	13 529	13 095	19 717	18 901
7801.99	Lead, unwrought, n.e.s.	68 937	63 387	56 203	48 090
7802.00	Lead waste and scrap				
	United States	6 443	2 766	4 016	1 320
	Other countries	22	11	31	39
	Total	6 465	2 777	4 047	1 359
7803.00	Lead bars, rods, profiles and wire				
	United States	591	1 455	485	1 398
	Other countries	10	27	1	1
	Total	601	1 482	486	1 399
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	9	53	47	117
7804.19	Lead plates, sheet, strip and foil, n.e.s.	515	739	745	1 156
7804.20	Lead powders and flakes	–	–	6	61
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	33	83	18	152
7806.00	Other articles of lead				
	United States	. .	4 449	. .	4 752
	Other countries	. .	58	. .	21
	Total	. .	4 507	. .	4 773
IMPORTS[3]					
2607.00	Lead ores and concentrates				
	Peru	37 147	28 883	26 786	43 103
	United States	13 148	15 726	14 318	21 457
	Mexico	1 374	19 226	4 699	6 064
	Honduras	–	–	3 269	3 923
	Chile	–	–	10	3 131
	Morocco	–	–	9	2 712
	Other countries	5 474	10 863	1 487	2 532
	Total	57 143	74 698	50 578	82 922

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
2607.00.00.20	Lead content of lead ores and concentrates	55 877	43 829	47 300	56 373
2608.00.00.20	Lead content of zinc ores and concentrates	474	656	380	529
2616.10.00.20	Lead content of silver ores and concentrates	2 630	1 558	4 359	2 113
7801.10.10	Refined lead, unwrought, pig and block	6 037	5 169	4 747	4 370
7801.10.90	Refined lead, unwrought, other	184	235	179	206
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	4 867	4 731	4 177	4 241
7801.99	Lead, unwrought, other	2 488	10 111	8 431	38 157
7802.00	Lead waste and scrap				
	United States	109 954	23 819	65 616	14 334
	Other countries	156	115	54	40
	Total	110 110	23 934	65 670	14 374
7803.00	Lead bars, rods, profiles and wire				
	United States	1 075	1 999	1 535	2 104
	Other countries	21	105	11	20
	Total	1 096	2 104	1 546	2 124
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	217	341	311	387
7804.19	Lead plates, sheet, strip and foil, n.e.s.	101	195	152	230
7804.20	Lead powders and flakes	28	51	93	169
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	40	113	25	39
7806.00	Other articles of lead				
	United States	4 827	4 017	3 933	4 568
	Japan	841	1 055	508	657
	Germany	84	79	98	91
	China	16	27	45	56
	Other countries	100	145	109	102
	Total	5 868	5 323	4 693	5 474

	1998			1999p		
	Primary	Recycled[5]	Total	Primary	Recycled[5]	Total
	(tonnes)					
QUANTITY USED[4]						
Lead used for or in the production of:						
Antimonial lead	x	x	x	x	x	x
Batteries and battery oxides	11 421	17 106	28 527	16 741	20 024	36 765
Chemical uses: white lead, red lead, litharge, tetraethyl lead, etc.	x	x	x	x	x	x
Copper alloys: brass, bronze, etc.	94	13	107	14	11	25
Lead alloys:						
Solders	451	408	859	462	910	1 373
Others (including babbitt, type metals, etc.)	x	x	x	x	x	x
Semi-finished products:						
Pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	1 611	657	2 268	2 914	241	3 155
Other lead products	2 054	721	2 774	2 375	844	3 219
Total, all categories	28 109	59 447	87 466	34 108	58 449	92 557

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; p Preliminary; x Confidential.

[1] Production includes recoverable lead in ores and concentrates shipped valued at the Montréal Exchange average price for the year. [2] Lead content of domestic ores and concentrates exported. [3] Imports from "other countries" may include re-imports from Canada. [4] Available data, as reported by users. [5] Includes all remelt scrap lead used to make antimonial lead.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, LEAD PRODUCTION, TRADE AND USE, 1975, 1980 AND 1985-2000

	Production				Exports[1]			Imports	Quantity Used[3]
		Refined							
	All Forms[2]	Primary	Recycled	Total	In Ores and Concentrates	Refined	Total	Refined	
					(tonnes)				
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	1 962[■]	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	2 602[■]	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	5 675[■]	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	4 247[■]	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	12 558[■]	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 728
1989	268 887	157 330	85 515	242 845	170 582	121 444	292 026	11 734	88 408
1990	233 372	87 180	96 465	183 645	221 566	84 007	305 573	11 781	72 203
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 553	80 253
1992	339 626	151 252	101 633	252 885	190 822	131 546	322 368	8 289	92 420
1993	183 105	147 907	69 107	217 014	96 428	124 610	221 038	11 612	91 915
1994	167 584	153 035	98 605	251 640	55 923	133 203	189 126	5 119	95 764
1995	204 227	178 019	103 372	281 391	90 254	140 478	230 732	3 967[r]	91 171
1996	241 751	192 877	117 914	310 791	154 697	159 860[r]	314 557[r]	4 179[r]	93 373
1997	170 847	139 736	131 659	271 395	112 694	155 639	268 333	5 843	92 997
1998	150 019	129 750	135 737	265 487	52 250	145 358	197 608	6 458	87 466
1999	155 369	148 526	117 889	266 415	58 831	139 622	198 453	7 663	92 557
2000[p]	143 049	158 133	124 719	282 852	50 901	148 428	199 329	7 028	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; [p] Preliminary; [r] Revised.
[■] Lead in pigs, blocks and shot.

[1] Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20, 2608.00.20 and 2616.10.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10, 7801.10.90, 7803.00, 7804.11, 7804.19 and 7804.20.

[2] Recoverable lead in ores and concentrates shipped.

[3] Primary and recycled in origin, as measured by a survey of users.

TABLE 3. ANNUAL AVERAGE LEAD PRICES, 1975-2000

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(US¢/lb)	(US$/t)	(US¢/lb)
1975	413.48	18.75	441.93	18.82
1976	451.51	20.48	469.03	21.28
1977	617.78	28.02	626.84	28.43
1978	658.87	29.89	659.07	29.90
1979	1 203.15	54.57	1 149.95	52.16
1980	909.12	41.24	911.46	41.34
1981	734.73	33.33	750.12	34.03
1982	544.08	24.68	562.53	25.52
1983	425.27	19.29	440.55	19.98
1984	444.36	20.16	445.25	20.20
1985	394.10	17.88	394.12	17.88
1986	406.89	18.46	407.26	18.47
1987	597.41	27.10	567.38	25.74
1988	655.83	29.75	635.68	28.83
1989	676.14	30.67	659.36	29.91
1990	817.85	37.10	790.82	35.87
1991	557.84	25.30	568.90	25.81
1992	540.04	24.50	553.56	25.11
1993	406.38	18.43	420.36	19.07
1994	549.01	24.90	564.10	25.59
1995	630.51	28.60	638.88	28.98
1996	773.96	35.11	771.22	34.98
1997	624.08	28.31	633.01	28.71
1998	528.42	23.97	533.29	24.19
1999	502.24	22.78	508.89	23.08
2000	454.22	20.60	468.07	21.23

Source: London Metal Exchange.

TABLE 4. LME MONTHLY AVERAGE LEAD PRICES, 1999 AND 2000

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(USc/lb)	(US$/t)	(USc/lb)
1999				
January	492.30	22.33	489.00	22.18
February	513.65	22.30	515.35	23.38
March	507.83	23.04	508.72	23.08
April	519.33	23.56	508.72	23.08
May	541.53	24.56	543.13	24.64
June	496.11	22.50	505.16	22.91
July	495.80	22.49	505.86	22.95
August	502.65	22.80	511.05	23.18
September	507.32	23.01	520.11	23.59
October	497.10	22.55	508.79	23.08
November	478.32	21.70	489.09	22.19
December	479.05	21.73	494.35	22.42
2000				
January	472.08	21.41	488.18	22.14
February	452.38	20.52	470.24	21.33
March	441.30	20.02	456.59	20.71
April	421.14	19.10	439.75	19.95
May	412.12	18.69	430.43	19.52
June	419.59	19.03	436.36	19.79
July	452.12	20.51	462.60	20.98
August	473.09	21.46	485.82	22.04
September	487.05	22.09	493.26	22.37
October	486.14	22.05	493.00	22.36
November	468.02	21.23	481.27	21.83
December	462.34	20.97	477.11	21.64

Source: International Lead and Zinc Study Group.

TABLE 5. WESTERN WORLD LEAD MARKETS, 1996-99

	1996		1997		1998		1999	
	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)
Batteries	3 395.2	72.1	3 402.7	72.7	3 457.1	74.2	3 566.6	74.9
Cable sheathing	99.0	2.1	77.5	1.7	64.0	1.4	59.1	1.2
Rolled and extruded products	278.2	5.9	282.5	6.0	290.6	6.2	264.6	5.6
Shot/ammunition	108.6	2.3	109.5	2.3	111.9	2.4	113.4	2.4
Alloys	149.9	3.2	143.8	3.1	127.9	2.7	136.5	2.9
Pigments and other compounds	476.9	10.1	465.5	9.9	421.2	9.0	423.7	8.9
Gasoline additives	44.2	0.9	37.0	0.8	31.5	0.7	27.6	0.6
Miscellaneous	156.2	3.3	162.6	3.4	157.0	3.4	170.8	3.6
Total	4 708.2	100.0	4 681.0	100.0	4 661.2	100.0	4 762.3	100.0

Source: International Lead and Zinc Study Group.

TABLE 6. MINE PRODUCTION OF LEAD, BY COUNTRY, 1997-2000

	1997	1998	1999	2000p
	(000 t)			
EUROPE				
Bulgaria	32	22	14	14
Greece	19	23	19	16
Ireland	45	36	39	57
Italy	12	7	8	7
Macedonia	28	30	27	26
Poland	55	60	68	50
Romania	17	15	21	18
Russia	16	13	14	14
Spain	23	19	29	51
Sweden	109	112	118	107
Yugoslavia	14	16	9	2
Other Europe	7	5	–	–
Total Europe	377	358	366	362
AFRICA				
Morocco	77	80	80	84
Namibia	18	14	12	12
South Africa	83	84	80	75
Other Africa	2	4	7	9
Total Africa	180	182	179	180
AMERICAS				
Canada	186	190	162	149
Mexico	174	166	120	138
Peru	262	258	271	271
United States	459	491	513	451
Other Americas	195	180	132	149
Total Americas	1 129	1 146	1 105	1 047
ASIA				
China	712	581	549	570
India	33	38	38	36
Iran	19	13	15	15
Japan	5	6	6	9
Kazakhstan	29	26	31	39
Korea, South	35	30	26	22
Thailand	6	7	12	11
Turkey	10	12	14	10
Other Asia	17	12	4	1
Total Asia	858	722	696	718
OCEANIA				
Australia	486	584	633	652
Total Western World	2 130	2 243	2 255	2 230
Total World	3 030	2 992	2 979	2 958

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
– Nil; p Preliminary.

TABLE 7. REFINED LEAD PRODUCTION, BY COUNTRY, 1997-2000

	1997	1998	1999	2000p
	(000 t)			
EUROPE				
Belgium	111	92	110	119
Bulgaria	73	77	82	84
Czech Republic	22	24	25	28
France	283	289	273	262
Germany	329	353	353	387
Italy	212	199	215	231
Poland	65	64	70	70
Russia	52	36	44	32
Spain	90	90	86	120
Sweden	86	87	79	78
United Kingdom	399	370	372	335
Other Europe	168	167	138	144
Total Europe	1 890	1 848	1 847	1 890
AFRICA				
Morocco	64	62	65	69
South Africa	43	50	52	52
Other Africa	17	15	14	13
Total Africa	124	127	131	134
AMERICAS				
Brazil	53	48	52	50
Canada	271	266	266	285
Mexico	259	259	199	244
Peru	98	104	111	116
United States	1 431	1 436	1 447	1 433
Other Americas	70	69	61	63
Total Americas	2 182	2 182	2 136	2 191
ASIA				
China	708	757	918	1 034
India	60	66	64	67
Japan	297	302	293	312
Kazakhstan	82	92	159	208
Korea, North	30	25	22	19
Korea, South	182	180	190	220
Malaysia	36	29	33	35
Taiwan	36	39	45	42
Other Asia	171	163	164	158
Total Asia	1 602	1 653	1 888	2 095
OCEANIA				
Australia	229	200	271	257
New Zealand	6	6	6	5
Total Oceania	235	206	277	261
Total Western World	4 972	4 912	4 933	5 059
Total World	6 033	6 016	6 279	6 572

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
p Preliminary.

TABLE 8. REFINED LEAD USE, BY COUNTRY, 1997-2000

	1997	1998	1999	2000p
		(000 t)		
EUROPE				
Austria	61	66	64	64
Belgium	60	58	51	57
France	256	251	260	268
Germany	340	356	372	395
Ireland	29	26	32	31
Italy	259	262	279	281
Netherlands	57	51	30	32
Poland	57	59	64	68
Russia	103	92	95	83
Spain	170	188	192	231
United Kingdom	345	310	329	325
Other Europe	231	232	230	249
Total Europe	1 968	1 951	1 998	2 084
AFRICA				
Algeria	20	21	21	21
Egypt	9	8	8	9
South Africa	63	74	67	69
Other Africa	29	29	32	32
Total Africa	121	132	128	131
AMERICAS				
Brazil	110	110	108	114
Canada	71	67	70	68
Mexico	148	163	179	185
United States	1 664	1 744	1 791	1 789
Other Americas	112	114	100	113
Total Americas	2 105	2 198	2 248	2 269
ASIA				
China	485	505	524	550
India	88	95	112	119
Indonesia	66	40	45	46
Iran	68	70	75	75
Japan	330	308	289	301
Korea, South	292	236	272	306
Malaysia	73	62	76	84
Taiwan	141	132	150	145
Thailand	48	46	66	96
Other Asia	180	179	198	207
Total Asia	1 771	1 673	1 807	1 929
OCEANIA				
Australia	63	54	56	41
New Zealand	7	10	8	9
Total Oceania	70	64	64	50
Total Western World	5 259	5 238	5 433	5 626
Total World	6 034	6 018	6 244	6 463

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
p Preliminary.

TABLE 9. WESTERN WORLD PRODUCTION OF RECYCLED[1] LEAD, 1997-2000

	1997	1998	1999	2000p
		(000 t)		
EUROPE				
Austria	22	23	24	24
Belgium	27	33	77	107
France	159	158	150	137
Germany	198	192	192	216
Ireland	12	13	11	9
Italy	146	142	148	163
Netherlands	19	17	18	21
Spain	90	90	86	120
Sweden	43	48	44	47
United Kingdom	189	184	183	179
Other Europe	42	38	41	36
Total Europe	947	938	974	1 059
AFRICA				
Algeria	7	6	6	6
Morocco	4	4	4	4
South Africa	43	50	52	52
Other Africa	9	9	7	7
Total Africa	63	69	69	69
AMERICAS				
Brazil	53	48	52	50
Canada	132	136	118	126
Mexico	80	87	91	96
United States	1 089	1 099	1 097	1 091
Other Americas	65	68	60	55
Total Americas	1 419	1 438	1 418	1 418
ASIA				
India	17	17	19	25
Indonesia	30	22	18	18
Iran	28	29	28	26
Japan	154	158	168	182
Korea, South	61	47	50	50
Malaysia	36	29	33	35
Taiwan	36	39	45	42
Thailand	15	19	23	24
Other Asia	70	69	70	72
Total Asia	447	429	454	474
OCEANIA				
Australia	25	28	32	34
New Zealand	6	6	6	5
Total Oceania	31	34	37	38
Total Western World	2 907	2 908	2 953	3 058

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
p Preliminary.
[1] Refined lead and lead alloys (lead content) produced from scraps, wastes and residues.

Lime

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"Lime" is a general term referring to burned or calcined limestone (burnt lime or quicklime) and its secondary products, including hydrated lime (calcium hydroxide), also referred to as slaked lime. In the calcining process, quicklime (CaO or CaO.MgO) begins to form at the dissociation temperature of limestone. Temperatures are maintained sufficiently long until there is a complete breakdown of the limestone and a release of the carbon dioxide content. High-calcium quicklime containing mainly CaO and less than 5% MgO is the most common type of lime produced. However, dolomitic quicklime (or dolime) and its hydrated products are also produced; these products contain 35-40% MgO.

CANADIAN INDUSTRY

Canadian shipments of all lime in 2000 amounted to 2.55 Mt valued at $240 million based on preliminary data. These amounts are essentially the same as in 1999 (Tables 1 and 2). Quicklime accounted for about 90% of the total volume and value of shipments. Production figures do not include some captive production from pulp and paper plants that burn sludge to recover lime for re-use in the causticization process. Similarly, beginning with 1996 data, General Chemical Canada Ltd. has not been included in the production figures because this company's main output is the manufacture of derived chemicals.

The lime industry in Canada comprises 17 operating plants from New Brunswick to British Columbia (Figure 1 and Table 3). Total employment in the industry in 1999 (the most recent year for which Statistics Canada data are available) was approximately 765 compared to 830 in 1998. Calcining capacity to produce quicklime did not change appreciably; the effective capacity utilization is estimated to be 80%.

The Graymont group of companies, with eight plants across Canada and several plants in the United States, now accounts for an estimated 30% of total lime capacity in North America. Official name changes relating to this group's operations became effective in mid-2000. Carmeuse North America Group, with complete or partial ownership of four plants in Ontario, is the leading producer of lime in North America. Chemical Lime Company of Canada Inc., with one operation in British Columbia, is the second largest lime producer in North America.

USE

The types or forms of lime commercially available are essentially the same as reported in detail in the chapter on lime appearing in the 1998 edition of the *Canadian Minerals Yearbook*.

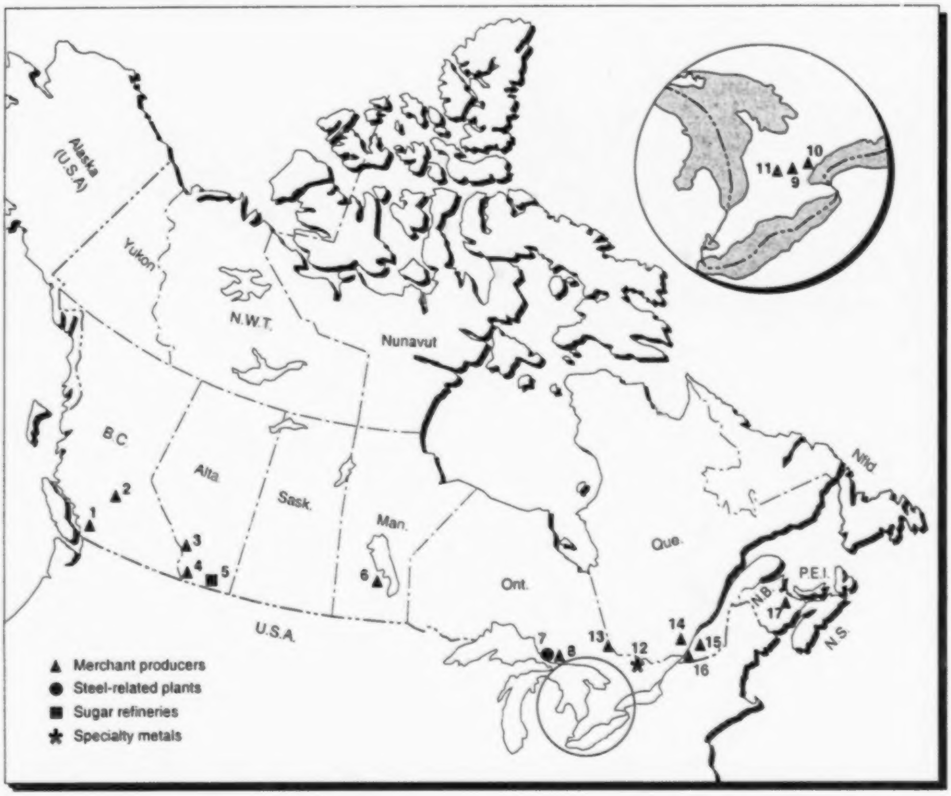
The use of lime in Canada, or essentially its complete consumption in the manufacture of numerous products, relates mainly to the merchant market, which is served by the mainstream lime producers.

The use of quicklime, based on reported shipments for the merchant market, amounted to 1 415 738 t in 2000. The major end uses were steel-making (45%), environmental control (13%), pulp and paper (15%), chemicals (11%), and other industrial uses, including metal concentration (16%). Hydrated lime shipments in the merchant market amounted to 155 555 t in 2000 and were sold mainly for environmental control (58%), other industrial uses (24%), agricultural uses (3%), and other miscellaneous uses related mainly to road and soil stabilization and other construction and masonry (14%).

ENERGY AND TECHNOLOGY

Energy costs to produce quicklime account for about 40% of total production costs, one of the highest ratios in the mineral processing sector. Calcining takes place mainly in vertical (shaft-type) kilns or rotary-type kilns, the latter technology being most common in North America. Preheater systems and computerized process control systems are now commonplace.

Figure 1
Lime Producers in Canada, 2000


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
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14
15
16
17
▲ Merchant producers
● Steel-related plants
■ Sugar refineries
★ Specialty metals

Numbers refer to locations on map above.

MERCHANT PRODUCERS

1. Chemical Lime Company of Canada Inc., Fort Langley
2. Graymont Western Canada Inc., Pavilion Lake
3. Graymont Western Canada Inc., Exshaw
4. Graymont Western Canada Inc., Summit plant, Hazell
6. Graymont Western Canada Inc., Faulkner
8. Northern Lime Limited, Spragge
9. Global Stone Ingersoll Ltd.,[1] Ingersoll
10. Lafarge Lime (Canada) Inc., Dundas Division
11. Beachville Lime Limited, Ingersoll
13. Miller Minerals, Haileybury
14. Graymont (QC) Inc., Joliette
15. Graymont (QC) Inc., Marbleton
16. Graymont (QC) Inc., Bedford
17. Graymont (NB) Inc., Havelock

STEEL-RELATED PRODUCERS

7. Algoma Steel Inc., Sault Ste. Marie

SUGAR REFINERIES

5. Rogers Sugar Ltd., Taber

SPECIALTY METALS

12. Timminco Limited, Haley Station

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[1] Closed in March 2000.

About 50% of the kilns in service in Canada use natural gas, with petroleum coke, coal and heating oils accounting for the energy inputs required for the calcining process. Kiln efficiencies depend on the type of design and generally range from 4 to 5 gigajoules per tonne (GJ/t) of calcined lime for shaft kilns to as much as 13 GJ/t for long rotary kilns not equipped with preheaters. Other types of kilns of comparatively recent design are the rotary hearth, travelling grate, fluo-solid, and inclined vibratory kiln. Dust-collecting equipment to meet current environmental control regulations is required for all systems.

PRICES

Published prices for lime represent only a broad range. Actual prices vary according to marketing strategies and supply and demand. Average prices for high-calcium quicklime and high-calcium hydrated lime, f.o.b. plant, in Ontario, in bulk, were quoted at $70.80/t and $80.40/t respectively at the end of 2000.

INTERNATIONAL DEVELOPMENTS

In 2000, world lime production was an estimated 117 Mt, compared to 116 Mt in 1999 (Table 5). The United States and China, accounting for 20 Mt and 22 Mt respectively, were followed by Japan and Germany with 7.7 Mt and 7.6 Mt respectively.

Canada ranks in the top 10 lime-producing countries (2.6 Mt of lime shipped) because of relatively large chemical and industrial requirements. Reserves of limestone are relatively large and the proximity of lime plants to U.S. markets has resulted in a favourable balance of trade in lime products, as shown in Table 2.

The United States produced 20.1 Mt of lime in 2000 compared to 19.6 Mt in 1999, according to preliminary figures. Apparent use amounted to 20.3 Mt in 2000 compared to 19.7 Mt in 1999. Environmental uses for lime in the United States, which include flue gas sulphur removal, water treatment and wastewater treatment, have grown rapidly and are the third most important uses after metallurgical, chemical and industrial uses.

OUTLOOK

The production of lime in Canada in 2001 is expected to decrease by 10% compared to 2000 based mainly on weaker demand by steel and pulp and paper producers.

In the medium to longer term, demand for lime as a flux in steel-making is forecast to decline because of several factors. These include: improved efficiencies in steel production and energy inputs, the use of larger amounts of scrap in basic oxygen furnaces, improved ore grades, more use of fluxed iron ore pellets, and growth of the mini-mill sector, which makes steel from scrap iron in electric furnaces.

Lime is now marketed to several industries more as a specialty chemical than as a commodity because certain uses demand stricter specifications relating to ISO standards. In particular, these standards may apply to: 1) lime and dolime for steel-making; 2) the processing of lime for precipitated calcium carbonate (PCC) for a range of industrial uses; 3) lime for flue-gas desulphurization technology to make commercial-quality synthetic (FGD) gypsum; and 4) high-purity lime for water treatment. The use of lime in the environmental sector is expected to increase in the short term given the importance of treating effluents in the industrial and mining sectors.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of February 1, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

PRICES

Canadian lime prices quoted in *Camford Chemical Report*	December 1999	December 2000
	($ per tonne)	
Lime, carload and truckload		
f.o.b. Ontario plant		
High-calcium quicklime, bulk	70.80	70.80
High-calcium hydrated lime, bulk	80.40	80.40

f.o.b. Free on board.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2522.10	Quicklime	Free	Free	Free	Free
2522.20	Slaked lime	Free	Free	Free	Free
2522.30	Hydraulic lime	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, LIME PRODUCTION AND TRADE, 1999 AND 2000

Item No.		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION[1]					
	By type				
	Quicklime	2 299 705	209 843	2 292 900	212 289
	Hydrated lime	265 746	29 050	253 648	27 927
	Total	2 565 451	238 893	2 546 548	240 216
	By province/territory				
	Newfoundland	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	x	x	x	x
	Quebec	x	x	x	x
	Ontario	1 380 321	121 950	1 313 140	117 105
	Manitoba	x	x	x	x
	Saskatchewan	–	–	–	–
	Alberta	x	x	x	x
	British Columbia	x	x	x	x
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	2 565 451	238 893	2 546 548	240 216
IMPORTS[2]					
2518.20	Calcined dolomite				
	United States	3 078	615	3 810	761
	Canada	756	86	320	35
	Total	3 834	701	4 130	796
2522.10	Quicklime				
	United States	37 815	4 564	45 501	4 802
	Switzerland	129	22	218	23
	India	13	3	7	1
	Canada	22	4	1	. . .
	Pakistan	1	. . .	–	–
	Total	37 980	4 593	45 727	4 826

TABLE 1 (cont'd)

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS[2] (cont'd)					
2522.20	Slaked lime				
	United States	5 855	1 222	7 054	1 538
	France	–	–	51	15
	Total	5 855	1 222	7 105	1 553
2522.30	Hydraulic lime				
	United States	10 599	1 886	9 686	1 718
	United Kingdom	6	2	13	4
	Belgium	16	5	–	–
	Israel	66	13	–	–
	Pakistan	13	4	–	–
	Total	10 700	1 910	9 699	1 722
EXPORTS					
2518.20	Calcined dolomite				
	United States	29 466	6 696	15 749	4 112
	India	110	30	–	–
	Total	29 576	6 726	15 749	4 112
2522.10	Quicklime				
	United States	79 089	10 857	68 236	9 625
	Total	79 089	10 857	68 236	9 625
2522.20	Slaked lime				
	United States	16 943	2 353	12 382	1 801
	Total	16 943	2 353	12 387	1 802
2522.30	Hydraulic lime				
	United States	26	4	1	5
	China	–	–	7	3
	Total	26	4	8	8

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary; x Confidential.
[1] Producers' shipments and quantities used by producers. [2] Includes re-imports.
Notes: Numbers may not add to totals due to rounding. HS code 2522.30, as interpreted, applies mainly to hydrated lime.

TABLE 2. CANADA, LIME PRODUCTION, TRADE AND APPARENT USE, 1975, 1980 AND 1985-2000

	Production[1]			Imports	Exports	Apparent Use[2]
	Quick	Hydrated	Total			
			(tonnes)			
1975	1 533 944	199 195	1 733 139	30 099	234 034	1 529 204
1980	2 364 000	190 000	2 554 000	40 901	403 166	2 191 735
1985	2 054 294	157 286	2 211 580	23 056	194 097	2 040 539
1986	2 069 043	173 534	2 242 577	46 917	189 512	2 099 982
1987	2 140 793	189 278	2 330 071	44 290	163 767	2 210 594
1988[a]	2 306 831	211 151	2 517 982	32 543	122 900	2 427 625
1989	2 349 312	202 622	2 551 934	39 095	83 608	2 507 421
1990	2 137 996	202 741	2 340 737	43 715	138 409	2 246 043
1991	2 184 836	190 424	2 375 260	45 012	134 405	2 285 867
1992	2 193 752	190 592	2 384 344	55 706	173 248	2 266 802
1993	2 186 749	192 247	2 378 996	52 690	190 068	2 241 618
1994	2 250 205	198 818	2 449 023	66 886	193 902	2 322 007
1995	2 244 800	216 916	2 461 716	52 884	266 475	2 248 125
1996	2 134 437	267 595	2 402 032	36 639	216 849	2 221 822
1997	2 219 385	257 186	2 476 571	47 382	224 232	2 299 721
1998	2 204 957	256 086	2 461 043	33 988	171 446	2 323 585
1999	2 299 705	265 746	2 565 451	54 535	96 058	2 523 928
2000[p]	2 287 143	254 142	2 541 285	62 531	80 626	2 523 190

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.
[a] Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS classes 2522.10, 2522.20 and 2522.30.
[1] Producers' shipments and quantities used by producers. [2] Production plus imports, less exports.

TABLE 3. CANADIAN LIME INDUSTRY, 2000

Company	Plant Location	Calcining Capacity	Market	Type of Quicklime and Other Products
		(000 t/y)		
NEW BRUNSWICK				
Graymont (NB) Inc.	Havelock	175	Merchant	High-calcium[1]
QUEBEC				
Graymont (QC) Inc.	Marbleton	330	Merchant	High-calcium[1]
Graymont (QC) Inc.	Joliette	200	Merchant/captive	High-calcium[1]
Graymont (QC) Inc.	Bedford	200	Merchant	High-calcium
ONTARIO				
Algoma Steel Inc.	Sault Ste. Marie	200	Captive	High-calcium and dolomitic
Beachville Lime Limited	Ingersoll	600	Merchant	High-calcium[1] and dolomitic
Miller Minerals, a division of Miller Paving Limited	Haileybury	40	Merchant	High-calcium
Northern Lime Limited	Spragge	200	Merchant	High-calcium and dolomitic
Lafarge Lime (Canada) Inc., Dundas Division	Dundas	345	Merchant	High-calcium and dolomitic
Global Stone Ingersoll Ltd.[2]	Ingersoll	215	Merchant/captive	High-calcium
Timminco Limited	Haley Station	53	Captive	Dolomitic
MANITOBA				
Graymont Western Canada Inc.	Faulkner	117	Merchant	High-calcium
ALBERTA				
Rogers Sugar Ltd.	Taber	66	Captive	High-calcium
Graymont Western Canada Inc.	Exshaw	130	Merchant	High-calcium[1]
Graymont Western Canada Inc., Summit plant	Hazell	50	Merchant	High-calcium and dolomitic[1]
BRITISH COLUMBIA				
Graymont Western Canada Inc.	Pavilion Lake	235	Merchant	High-calcium
Chemical Lime Company of Canada Inc.	Fort Langley	135	Merchant	High-calcium[1]

Source: Natural Resources Canada.

[1] Production of hydrated lime. [2] Closed in March 2000.

Note: Lantic Sugar Limited operates sugar refineries in Quebec and New Brunswick.

TABLE 4. CANADA, USE[1] OF DOMESTIC LIME, QUICK AND HYDRATED, 1997-2000

End Uses	1997	1998	1999	2000
			(tonnes)	
CHEMICAL AND INDUSTRIAL				
Steel-making	807 000	707 482	780 877	632 284
Water and sewage treatment	278 986	310 510	296 053	224 074
Water purification	52 026	48 366	51 323	37 445
Gas scrubbing	9 376	15 060	16 309	7 629
Metal concentration	151 258	158 482	138 431	153 469
Pulp and paper mills	225 363	200 824	213 627	218 878
Chemicals	126 375	193 693	194 362	161 408
Other industrial uses	73 879	96 416	101 102	109 645
CONSTRUCTION				
Road and soil stabilization	12 458	14 323	15 810	9 586
Mason and finishing lime	7 252	1 684	1 591	917
Other	13 851	17 807	22 126	11 259
AGRICULTURE	4 509	1 051	2 512	4 699
Total use	1 762 334	1 765 697	1 834 124	1 571 293

Source: Natural Resources Canada, based on producing companies' surveys, 1997-2000.

[1] Includes merchant market only; excludes companies that are completely captive producers/users.

TABLE 5. WORLD PRODUCTION OF QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE SOLD AND USED, 1996-2000

	1996	1997	1998	1999	2000[p]
			(000 tonnes)		
Canada	2 400	2 500	2 460	2 570	2 550
Brazil	5 700	5 700	5 700	5 700	5 700
China	20 000	20 500	21 000	21 500	22 000
France	3 000	2 800	2 800	2 400	2 400
Germany	8 000	8 000	7 600	7 600	7 600
Italy[1]	3 500	3 500	3 500	3 500	3 500
Japan[2]	7 676	7 850	8 100	7 750	7 700
Mexico	6 600	6 600	6 600	6 600	6 600
Poland	2 500	2 500	2 500	2 500	2 500
United Kingdom	2 500	2 500	2 500	2 500	2 500
United States	19 100	19 700	20 100	19 600	20 100
Other countries	40 200	37 850	33 050	33 650	33 900
Total	121 180	120 000	115 910	115 870	117 050

Sources: Natural Resources Canada; Statistics Canada; U.S. Geological Survey.

[p] Preliminary.

[1] Includes hydraulic lime. [2] Quicklime only.

Magnesium

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World production of primary and recycled magnesium increased to an estimated 585 000 t in 2000, up 6% from an estimated 530 000 t in 1999.[1] Magnesium use figures for 1999 were published in 2000 by the International Consultative Group on Nonferrous Metals Statistics. Prices for magnesium generally weakened during the year, due mainly to continued high shipment levels from China.

The International Magnesium Association (IMA) reports that Western primary magnesium production (which excludes China, the former Soviet Union and Israel) decreased by 17% (41 900 t) to 210 300 t in 2000 from 252 200 t in 1999. That decrease was due primarily to the closure of The Dow Chemical Company's plant in the United States.

The IMA also reported that shipments of magnesium in North America from primary producers were 176 700 t in 2000 compared to 215 200 t shipped in 1999. This decrease reflects changes in the methodology for collecting statistics, resulting from about a 30 000-t decrease in die-casting sector shipments, where shipments of recycled scrap from primary producers were previously included. North America (48%) and Western Europe (33%) are the largest magnesium-using regions.

IMA data also indicate that inventories of primary magnesium increased in 2000 to 46 500 t at year-end compared to 45 900 t at the end of 1999. This inventory represents approximately 46 days of world production of primary magnesium. (Further information from the IMA can be obtained at http://www. intlmag.org.)

CANADIAN DEVELOPMENTS

In 2000, Canada was the third largest magnesium producer in the world after China and the United States.

Norsk Hydro Canada Inc. (Norsk Hydro), a wholly owned subsidiary of Norsk Hydro ASA of Norway, has produced magnesium metal at a 43 000-t/y Bécancour, Quebec, plant using an electrolytic process since 1989. The plant also recycles magnesium scrap produced by its customers. Norsk Hydro has focussed on debottlenecking the existing operations and making them more efficient. Expansion may take place in the future provided sufficient customer contractual commitments for the production are in place. Cost-cutting measures have been implemented at the plant and, as part of these measures, the company laid off 85 people in early 2001. The company has developed a new alloy for use in environments with elevated temperatures. (Additional information is available on the Internet at http://www.magnesium.hydro.com.)

Timminco Limited produces high-purity metal (up to 99.98% pure) for specialized market applications at its 6000-t/y magnesium plant at Haley Station, Ontario. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. Timminco's magnesium products are used for a variety of applications such as alloying agents for aluminum and calcium, in Grignard reagents for the pharmaceutical industry, and in electronic products. Timminco uses the Pidgeon magnesium process in which calcined dolomite is reduced by ferrosilicon in a vacuum retort. Timminco mines the dolomite at the plant site but purchases the ferrosilicon feed on the open market.

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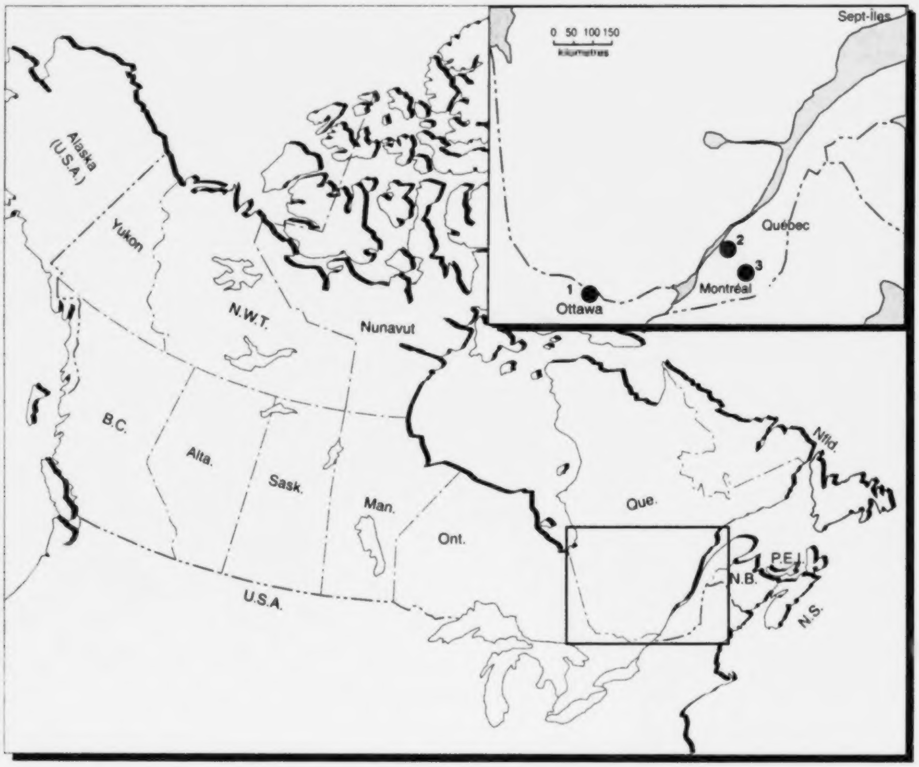
[1] Magnesium statistics vary between sources. Readers are cautioned to ensure data are appropriate for their needs. Including the China Magnesium Association's production figure, the comparable figures are a production in 2000 of 614 000 t, up 10% from 567 000 t in 1999. Note that statistics on magnesium use produced by both the IMA and Natural Resources Canada (NRCan) for casting and other uses have included, and may include, scrap components and may be/may have been overstated. The IMA has changed its reporting system and work is under way at NRCan to resolve these potential problems in the Canadian statistics.

In 2000, Timminco restructured and streamlined its operations to become more profitable. The company closed its corporate offices in Toronto and Haley Station, Ontario, and in Illinois, to focus on its corporate operations in Denver. In November 2000, both induction furnaces and related electrical cooling and control systems in a new, technically advanced, $25 million cast-house were damaged after a metal spill. The metal spill caused one of the cooling lines to rupture and resulted in a fire that required a temporary shut-down of the facility, including layoffs of some staff, until early 2001. The new cast-house re-opened in early 2001 and commercial production was to start in the second quarter. The casting facility at Haley Station provides magnesium billets for Timminco's extrusion facilities at Haley Station, Ontario, and Aurora, Colorado. On a longer-term basis, the company intended to expand operations in the wrought products area. (Timminco has an Internet site at http://www.timminco.com.)

In early 2001, Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) completed construction of its 58 000-t/y commercial magnesium plant in Danville, Quebec. The $950 million plant started producing magnesium metal in October 2000, creating 350 jobs. The metal produced at the plant is of high quality and has had excellent reviews. Although the company faced some start-up problems, it expected to produce about 10 000 t of metal in 2001 and to reach full production levels in early 2003.

Figure 1
Magnesium Smelters, 2000



Smelter	**Company**	**Capacity (t/y)**
1. Haley Station, Ontario	Timminco Limited	6 000
2. Bécancour, Quebec	Norsk Hydro Canada Inc.	43 000
3. Danville, Quebec	Magnola Metallurgy Inc.	58 000

Noranda Magnesium Inc. has developed a new high-temperature alloy system based on magnesium-aluminum-strontium. The alloy demonstrates better creep resistance at higher temperatures than most other magnesium alloys. The alloy, which also has good corrosion resistance, shows great potential to provide an affordable composition for applications such as automotive power trains. Noranda is now marketing this alloy, as well as pure magnesium and magnesium-aluminum alloys. The company is now a full-service magnesium supplier offering a range of pure and alloy products, as well as technical and research and development support to its customers.

Magnola Metallurgy Inc. cast its first magnesium ingot at a pilot plant in Salaberry-de-Valleyfield, Quebec, in March 1997. The ingot was the first of its kind and was produced by an innovative process that was developed over the last 10 years by researchers at the Noranda Technology Centre. Noranda's proprietary process enables the production of magnesium metal from the mining residues of local asbestos mines. The plant is expected to be the world's lowest-cost producer of magnesium. (Additional information is available on the Internet at http://www.norandamagnesium.com.)

In Canada, as in the rest of the world, there has been continued interest in the production of magnesium metal from dolomite deposits or from previously mined asbestos deposits. The Canadian projects include: Gossan Resources Limited at Inwood, Manitoba; Cassiar Mines and Metals Inc. at Cassiar, British Columbia; Globex Mining Enterprises Inc.'s magnesite-talc project at Timmins, Ontario; Canadian Magnesium Corporation at Baie Verte, Newfoundland; and another asbestos-based project at Thetford Mines, Quebec.

Gossan Resources Limited has maintained its interest in a dolomite property at Inwood, Manitoba, with a dolomite resource estimated at 67 Mt grading 21.6% magnesium oxide, with additional inferred resources. Tests on this material have shown that production of commercial-grade magnesium metal is possible using the Magnetherm process. Gossan discussed production from the deposit with metal producers in South Africa and the United States, and completed an economic assessment study of the proposed project, which shows a 15% internal rate of return. (Gossan has an Internet site at http://www.gossan.ca.)

Cassiar Mines and Metals Inc. continues planning for a US$600 million magnesium metal project with a capacity of 70 000-90 000 t/y based on asbestos mining residues in northern British Columbia. The company has a stockpile of 23 Mt of serpentine tailings that grade approximately 24% magnesium. The metal project could be carried out in addition to the company's project to recover asbestos fibre from tailings at the former Cassiar Asbestos Corporation Limited's asbestos mine at Cassiar in northern British Columbia although, in December 2000, a fire damaged the fibre mill, slowing that project. In 2000, the company converted all of its debt to common shares and planned to complete financing and other studies, including a banking report due in early 2001. If discussions on senior financing are successful, the company plans to start production in late 2003. The company changed its name in mid-2001 to Cassiar Resources Inc. (Cassiar has an Internet site at http://www.cassiarmagnesium.com.)

Canadian Magnesium Corporation (CMC) has proposed a project to extract magnesium oxide from serpentine in the tailings at the former Baie Verte asbestos mine in Newfoundland. In 1999, CMC completed pre-feasibility studies and bench-scale testing on mineral residues. Results of the work were positive and indicated that a clean product could be produced. The company continues to review its financing options prior to committing to piloting and marketing studies.

In early 2000, Globex Mining Enterprises Inc., a mining exploration company based in northwestern Quebec, acquired the Deloro magnesite deposit located 13 km southeast of Timmins, Ontario. The company reports that previous exploration on the magnesite-talc deposit has delineated approximately 100 Mt of material grading more than 50% magnesite, with 25-30% talc, to a depth of 120 m in a zone 1800 m by up to 300 m, open at depth. Reports on previous metallurgical work have also indicated the potential to produce high-purity magnesia and magnesium metal from the deposit. In addition, the work has shown that by-products of talc and silica may also be obtained from the deposit. The talc is fibre-free and light-coloured and can be used for cosmetics or the pulp and paper industry. Local markets may also be developed for the silica component of the mineralization. In early 2001, the company signed a contract with Hatch Associates to conduct a scoping study and outline a work plan for a bankable feasibility study for the project. (Globex Mining has an Internet site at http://www.globexmining.com.)

The town of Thetford Mines, Quebec, started a prefeasibility study on a proposal to process mining residues from asbestos mines into magnesium metal. The town reports that more than 300 Mt of material grading approximately 24% magnesium is available in the area for processing. Work was under way to find and license a process that could be used to extract the magnesium. Discussions were also under way with possible partners in the project.

Canadian magnesium production data are confidential due to the limited number of companies reporting. Figures quoted in Table 3 are those estimated by the U.S. Geological Survey and provided to the International Consultative Group on Nonferrous Metals Statistics. These estimates include recycled magnesium.

WORLD DEVELOPMENTS

The most important factor in the world magnesium market situation continues to be the increased production (and exports) of magnesium from China. Production from China has rapidly increased over the past nine years from about 5000 t in 1990 to 193 567 t in 2000, as reported by the China Magnesium Association. This increase has resulted in a decrease in the price of magnesium, especially in markets that are not protected by tariff barriers. Continued availability of this lower-priced magnesium is expected to result in the increased use of magnesium, but not without cost to existing producers.

The second most important factor in the magnesium market remains the large number of proposed new projects. If only a few advance to fruition, global primary magnesium metal production would expand considerably. While it is unlikely that all of these projects will proceed, it is likely that magnesium supplies could be available for an accelerated rate of growth in demand should prices not decrease substantially from their present levels.

According to the IMA, shipments of primary magnesium from producers in 2000 were 366 900 t, down 8600 t, or approximately 2% from the reported record 375 500 t in 1999. It must be remembered, however, that approximately 30 000 t of recycled magnesium were removed from the shipment statistics from primary producers, and this drop results from a change in the methodology for collecting statistics. Shipments for aluminum alloys were up 3%, reflecting the increased aluminum production, and shipments for desulphurization were up 23%, reflecting increased shipments of lower-priced Chinese magnesium into this market.

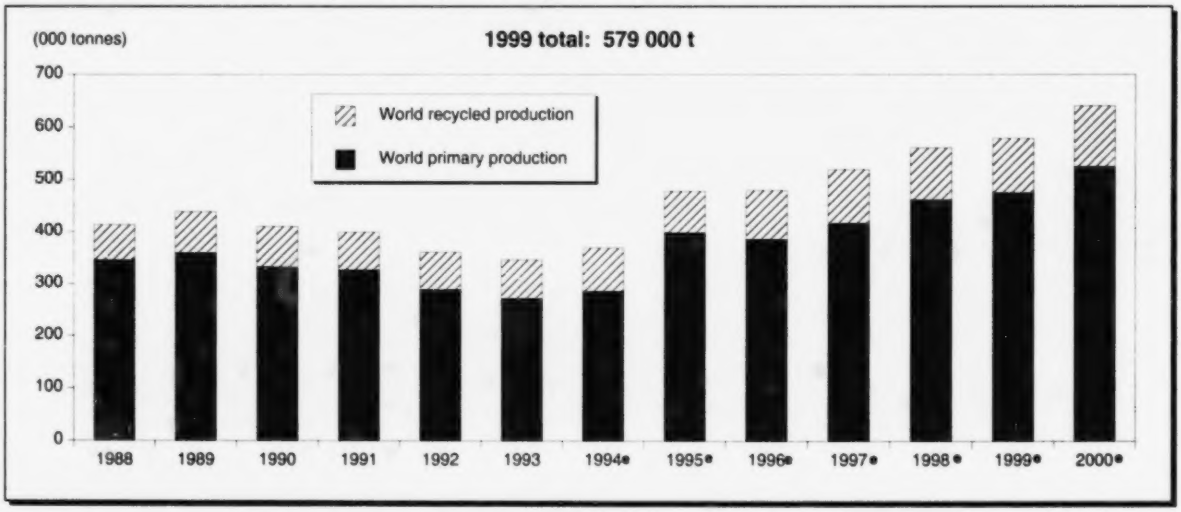
As in the aluminum industry, the magnesium industry, including the casters and other industry users of unwrought metal, as large users of energy, have been affected by higher energy prices. For example, the reported tripling of energy costs for the production of die castings has required some North American casters to impose energy surcharges on shipments. At the time of writing, plant closures had not occurred but, for companies suffering with other problems, closures could occur.

United States

At the end of 2000, the United States had two operating primary magnesium smelters. These were Magnesium Corporation of America (Magcorp), which operates a 43 000-t/y electrolytic plant in Rowley, Utah, and Northwest Alloys, Inc., which operates a 38 000-t/y silicothermic magnesium plant in Addy, Washington.

Magcorp, a wholly owned subsidiary of Renco Metals, Inc., concentrates brine from the Great Salt Lake in Utah to produce a magnesium chloride feedstock. The resulting magnesium chloride is reduced in electrolytic cells and the resulting metal is then refined

Figure 2
World Production of Primary and Recycled Magnesium, 1988-2000

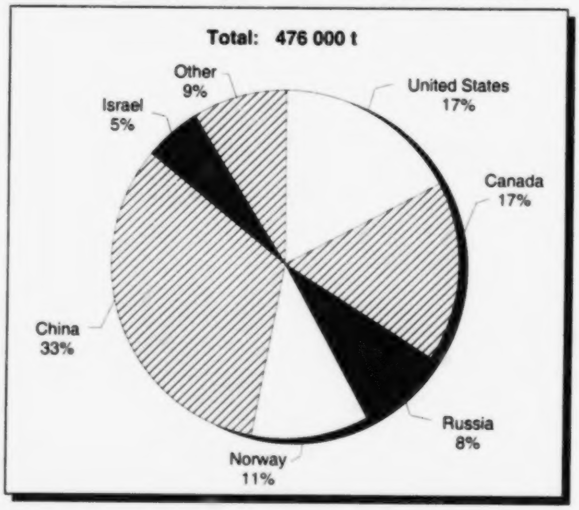


Sources: International Consultative Group on Nonferrous Metals Statistics; China Magnesium Association (China production data); Natural Resources Canada.

• Estimated.

Figure 3

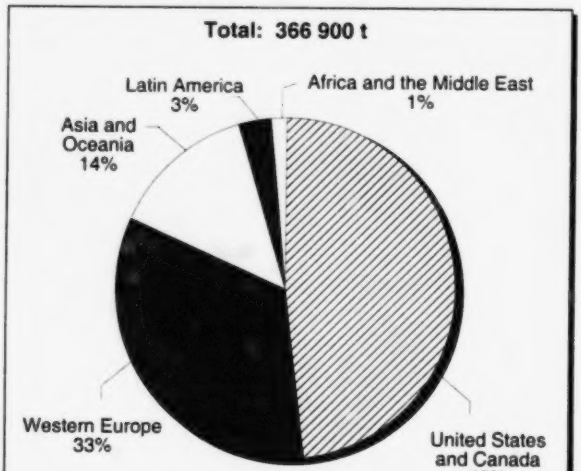
World Primary Magnesium Production,^{e} 1999



Sources: International Consultative Group on Nonferrous Metals Statistics (ICG); China Magnesium Association (CMA); Natural Resources Canada.
e Estimated.
Note: The ICG reports that China produced 70 500 t while the CMA reported production of 157 000 t. The latter figure is used for China's production.

Figure 4

Destination of Magnesium Shipments, 2000^{e}



Source: International Magnesium Association.

and cast into various products. As the company has been reported to generate a 25 000-t/y chlorine surplus, some of which is emitted, it has started efforts to reduce those emissions. In 2000, the company continued work on an upgrading program that began in 1997 to develop a more efficient electrolytic cell technology and to meet new environmental standards for chlorine emissions. In early 2001, the U.S. Environmental Protection Agency filed a lawsuit against Magcorp for past emissions and site clean-up.

Magcorp started conversion of cells in late 2000 and planned to start producing magnesium from these cells in mid-2001. The conversion is expected to reduce Magcorp's metal production over the two years required to complete the work, but the replacement of cells in one half of the plant was expected to increase the plant's capacity by 33%. Once completed, the company expected to construct a line of new cells to further increase the plant's capacity to 60 000 t/y. (Additional information is available on the Internet at http://www.epa.gov and http://www. magnesium-corp.com.)

Northwest Alloys, Inc., a subsidiary of Alcoa Inc., uses the Magnetherm silicothermic process at its Addy plant to produce magnesium by reducing dolomite with ferrosilicon. The bulk of Northwest Alloy's production is shipped for use by Alcoa subsidiaries in aluminum alloys. The company planned to operate at a reduced rate of 30 000 t/y in 2001, due in part to closures of aluminum smelting operations in the western United States.

In October, Xstrata AG finalized the purchase of magnesium scrap processing technology from JCD Ltd. and completed a feasibility study on construction of its first scrap facility in the United States. JCD's process was reported to make high-purity alloys from magnesium scrap at a more competitive cost than other processes. In January 2001, subsidiary Xstrata Magnesium Corporation announced that it had selected Anderson, Indiana, as the location for its first scrap recycling facility in the mid-western United States. The company will invest US$23 million to convert an existing building. Local and state tax credits and grants to Xstrata amounted to over US$1 million. Xstrata's future plans include possible additional plants in Europe and Asia. (Xstrata has an Internet site at http://www.xstrata.com.)

The U.S. Department of Commerce's International Trade Administration (ITA) completed a full five-year sunset review for pure and alloy magnesium from Canada. *The Uruguay Round Agreements Act* requires the U.S. Department of Commerce and the U.S. International Trade Commission (ITC) to conduct these sunset reviews no later than five years after an anti-dumping or countervailing duty order is issued. Final results of the sunset review, published in July 2000, maintained the countervailing duty orders on pure and alloy magnesium from Canada and the anti-dumping duty order on pure magnesium. The ITC determined and imposed a countervail rate of 1.84% on imports from Norsk Hydro and 7.34% on all others, and an anti-dumping rate of 21.6%. In late 2000, the Government of Quebec filed a request for a review of this decision by an independent bi-national panel under Chapter 19 of the North American Free Trade Agreement (NAFTA) but, at the time of writing, no final decisions had been made. The Department of Commerce also conducted an administrative review of countervailing duty orders on pure and alloy magnesium for the period from January 1, 1998, to December 31, 1998, and determined the rate for the period as 1.38% and, in an administrative review of the anti-dumping duty for the period August 1, 1998, through July 31, 1999, determined a margin of 0%. The Department, however, declined to revoke the anti-dumping duty order for Norsk Hydro as it does not have three consecutive years of sales in commercial quantities. (Additional information is available on the Internet at http://www.usitc.gov and http://www.nafta-sec-alena.org/english/index.htm.)

The U.S. ITA completed an anti-dumping duty sunset review of pure magnesium from China and determined that revocation of the anti-dumping duty order would likely lead to continuation or recurrence of dumping and determined a percentage weighted-average margin on a country-wide rate of 108.26%.

In late 2000, the U.S. ITA also initiated anti-dumping duty investigations on pure magnesium from Israel, the Russian Federation and China. In the case of Israel, the ITA made a preliminary determination in February 2001 of a countervail duty subsidy rate at 13.39% ad valorem and, shortly thereafter, that sales at less than fair value had taken place and the anti-dumping margin was 12.68%. In the case of China, the ITA also made a preliminary determination on dumping in early 2001, determining the rate was 8.75% for one exporter and 305.56% for all others, but postponed the final decision. In the case of the investigation on pure magnesium from Russia, the ITA made a preliminary determination that sales had not taken place at less than fair value. (Additional information is available on the Internet at http://ia.ita.doc.gov.)

In early 2001, the United States Automotive Materials Partnership (USAMP), as part of the United States Council for Automotive Research (USCAR), began a new structural cast magnesium development project to resolve the critical issues that limit the large-scale application of structural cast magnesium castings in automotive components. In addition, work is also being conducted through the Partnership for a New Generation of Vehicles (PNGV) on new power-train components, including ones from cast magnesium alloys. (Additional information is available on the Internet at http://www.uscar.org/news/releases/castmagnesium.html.)

Additional information on magnesium production in the United States, as well as other general information on magnesium, is available on the U.S. Geological Survey's Internet site at http://minerals.er.usgs.gov.

Europe

The Antheus Magnesium Project Group continued work on a proposed new magnesium metal plant in the Eemsmond region in Delfzijl metal park in the northeastern **Netherlands**. The Project Group included: Nedmag Industries Mining and Manufacturing, a producer of dead-burned magnesia and other magnesium compounds; Corus Aluminum; Noordelijke Ontwikkelings Maatschappij; and the Netherlands Ministry of Economic Affairs. The group completed a pre-feasibility study in 2000 and planned to start a bankable feasibility study with completion scheduled in 2001. The proposed magnesium plant could have an initial capacity of 30 000 t/y and would use magnesium salts produced by Nedmag. A decision on construction was expected in late 2001. The plant (with an associated casting and recycling operation) would start production in 2005 and would be built to easily accommodate a doubling of the production rate. (Additional information may be found on the Internet at http://www.nom.nl/uk/antheus.htm, http://www.nedmag.nl/home.htm, and http://www. antheus.nl.)

The European Commission (EC) continued its review of imports of unwrought unalloyed magnesium from China following a complaint by the Comité de Liaison des Industries de Ferro-Alliages of Euro Alliages (the European Alloys Association) on behalf of Pechiney SA's wholly owned subsidiary, Pechiney Électrométallurgie of France. (In 2000, Pechiney was the sole producer of magnesium in the European Union.)

In October 2000, the EC doubled the existing anti-dumping duty on imports of magnesium. The duty for unrelated parties remains the same as previously determined, that is, the difference between the minimum import price of 2622 ECU/t and any lower c.i.f. community frontier price. All other cases are subject to a revised ad-valorem duty of 63.4%. Later, in December, the Commission amended these anti-dumping measures, removing magnesium alloy ingots, including those for anode castings, from the original duty. As a result, magnesium-aluminum-zinc and magnesium-manganese alloys were added to the list of exclusions effective December 18, 2000. (Additional information is available on the Internet at http://europa.eu.int.)

Pechiney considered the closure of its 16 000-t/y plant in Marignac in southwestern **France** and started discussions with its workers on the closure in early 2001. (Pechiney has an Internet site at http://www.pechiney.com.)

With the increasing use of magnesium and the demand for recycling, a number of European facilities have been expanded or have announced the construction of new recycling facilities. These include Magnesium Elektron's new plant in Prague. The company decided to construct this new magnesium recycling plant in the **Czech Republic** in preference to previous plans for a site in Germany. The company expected the 10 000-t/y plant to use scrap from Germany and to produce at a rate of 7500 t/y in mid-2001, with operation at full capacity expected in 2002. Plans include an increase in capacity to 20 000 t/y when volumes of recycled metal increase. (Additional information is available on the Internet at http://www.luxfer.com and http://www.magnesium-elektron.com.)

Russia

Solikamsk Magnesium Works announced in early 2000 that it would construct a new US$95 million facility to increase its magnesium and magnesium alloy capacity by 15 000 t/y to bring it to 45 000 t/y. The company planned to obtain funds from existing shareholders and bank loans. Construction of the plant was expected to take two years. The new plant would use a new process developed in cooperation with the Russian Titanium & Magnesium Institute, based on one used at Solikamsk. A feed of synthetic carnallite would be produced from magnesium oxide with a brucite source for the magnesium oxide (to avoid the production of excess chlorine when natural carnallite or other magnesium chloride salts are used).

Russia's second primary magnesium producer is the Avisma Titanium-Magnesium Works at Berezniki, also in the Perm region. Avisma announced plans to increase the production of magnesium and magnesium alloys to 18 000 t/y and to increase its production capacity by 5000-7000 t annually to reach a capacity of 40 000 t/y by 2002. The company also continued its investigation into the use of alternate source feeds for magnesium production and tested a process using synthetic carnallite. The company planned to convert some of the capacity at its existing plant to the new feed and to reduce costs in this manner. The brucite would be sourced in the Khabarovsk district of eastern Russia where it is mined for the production of refractory materials. In conjunction with its expansion plans, Avisma was reported to have signed a renewable three-year agreement with Alcan to supply magnesium for use in alloys used for rolled and foil products. The company planned to produce 23 500 t of magnesium and magnesium alloys in 2000.

The Uralasbest Ural Asbestos Ore Mining and Processing Enterprise, JSC Uralasbest, in the Sverdlovsk region, sought investors for a proposed US$300 million plant to produce 50 000 t/y of magnesium. The company expected that construction of a plant would take three years. It had tested the extraction of magnesium and produced magnesium metal from its asbestos tailings in a pilot plant in 1999. It expected the proposed plant could produce magnesium metal for US$1640/t and that the plant could be in operation in 2005 once funding was obtained. The technology, which would be used for the production of magnesium at the company's asbestos mine, was developed at the Solikamsk Magnesium Works.

Ukraine

MMD Mineral, a mining company, studied the feasibility of re-opening the Kalush Potassium and Magnesium Works in the Ivano-Frankovsk region with a feed of bischoffite from its mine. The electrolytic plant, which had closed in January 1999, had an original capacity of more than 20 000 t/y but had been operating at a much lower rate using a magnesium salt feed from the Oriana fertilizer plant.

Kazakhstan

The Government of Kazakhstan continued work to privatize its remaining ownership in Ust-Kamenogorsk Titanium and Magnesium and expected to complete the sale of its 15.5% interest in 2001. The plant has produced magnesium for use in the production of titanium but has not produced significant quantities of magnesium since early 1994. This privatization is part of a state program to privatize a number of state-owned companies.

Israel

Dead Sea Magnesium Ltd. (DSM), a subsidiary of Israel Chemicals Ltd. and Volkswagen AG, completed its fourth full year of operation at its plant at Sdom, Israel. The plant was reported to have produced 28 000 t in 1999 and the company expected to increase its production capacity to 35 000 t/y in 2000. The company also considered construction of a diecasting plant in Dimonea, 40 km from the smelter, but postponed the start of construction until the metal plant became more profitable. (Additional information is available on the Internet at http://www.magnesium.co.il.)

Asia

China

As a result of the rapid development of China's primary magnesium industry and the limited demand in its domestic market, China has become a major exporter of primary magnesium to the Western World in recent years. China's exports have increased from almost none in 1990 to more than one third of world primary shipments in 2000. Since the United States imposed anti-dumping duties on China's unwrought magnesium, China's primary magnesium exports have been mainly focussed on European and Japanese markets.

China's magnesium metal production capacity, in approximately 500 plants, has been estimated at approximately 220 000 t/y. As most magnesium plants in China use a batch silicon thermal reduction process, the opening and closing of plants is relatively easy. In addition, the cost of ferrosilicon, an essential input into the production process, is relatively low within China, giving Chinese magnesium producers a cost advantage. However, power costs have increased and, coupled with government initiatives to reduce environmental damage and lower prices, the production growth rate will likely remain the same or decline in 2001.

Due to the current low prices for Chinese magnesium, many small plants are currently closed, but these could be re-opened should prices rise. Production in 2000 was reported by the China Magnesium Association to be 193 567 t. The Association expects that production will grow to about 205 000 t in 2001. It is working with Tsinghua University to develop the die-casting industry in the provinces of Guangdong and Shanxi. Reported plans and changes in operations have included:

- Wenxi Yinguang opened a new plant in Shanxi Province near its existing plant to expand capacity by 5000 t/y. The company is focussing on this expansion to provide alloys to local die-cast alloy consumers.

- Top Magnesium Co. in Shanxi Province planned to increase capacity to 10 000 t/y by the end of 2000.

- The Chinese government conducted studies for construction of a new 50 000-t/y plant in Qinghai Province using salt brines. Partners included the government and Minhe Magnesium.

- Norsk Hydro ASA started construction of a 10 000-t/y magnesium alloy ingot foundry in China in Xi'an, approximately 800 km southwest of Beijing. Norsk Hydro intends to produce high-quality alloy ingot from locally produced magnesium for export to traditional markets for die-casting alloys. Construction was expected to be completed in 2001.

- Taiyuan Minwei Magnesium Industry Co. Ltd., a joint venture between Minmet Financing Co. (60%) and Yi Wei Magnesium Group, established a 3000-t/y plant in Taiyuan City, Shanxi, for the production of pure magnesium and alloys.

Japan

Japan has no primary magnesium production but does have companies that use magnesium and recycle magnesium scrap to produce recycled magnesium. As is the case elsewhere in the world, there was increased interest in the recycling of magnesium in Japan as increasing amounts of consumer products containing magnesium reached the end of their life. As of April 2001, a new law required manufacturers to take back appliances, whether imported or locally manufactured. As a result, there has been an increased interest in recycling the contained metals, including magnesium. Nippon Kinzoku Corp. completed construction of a 2400-t/y magnesium recycling plant in Kitakami Iwate prefecture in northern **Japan**. The company expected that this plant would be operating at full capacity in early 2001. The company's recycling capacity in Japan will be 8000 t/y with this fourth plant.

A subsidiary of Sumitomo Metal Industries Ltd., Sumitomo Metals (Naoetsu) Ltd., a company producing precision rolled stainless steel and clad sheet products, conducted research into hot and cold rolling of magnesium. The company has produced sheet magnesium and continues to research the rolling of different alloys and increasing size ranges. The company expects to develop an integrated forming process from melting of the ingot through casting to hot and cold rolling.

Taiwan

Hydro Magnesium and CS Aluminum discussed a joint venture for a magnesium alloy recycling plant in **Taiwan** that would refine recycled die-casting magnesium to high-purity alloys.

India

In early 2000, the assets of Tamil Nadu Magnesium and Marine Chemicals Ltd. were liquidated to pay for debts incurred by the company. The company owned a 600-t/y silicothermic magnesium metal plant, constructed originally in 1990, but which had not recently been in operation.

Republic of the Congo (Brazzaville)

Magnesium Alloy Corporation (MagAlloy) continued work on its Kouilou project in the Republic of the Congo (Brazzaville). The project is based on two 2400-km^2 exploration permits in the Kouilou region. Previous exploration work for potash and oil has indicated the presence of potassium and magnesium salts, including carnallite, sylvanite and bischoffite.

In 1999, the company completed a feasibility study on a proposed 60 000-t/y plant in Pointe-Noire to solution mine the salt beds and to produce magnesium metal. The study by Salzgitter Anlagenbau GmBH proposed a US$514 million plant with an operating cost of US55¢/lb of magnesium. By-product chlorine, sodium chloride and potassium chloride would potentially provide additional revenue. The Russian National Aluminium and Magnesium Institute (VAMI) and the Ukrainian Titanium Institute's magnesium extraction technology would be used in the plant.

Magnesium Alloy signed a Memorandum of Understanding with Siemens AG for the completion of energy-related infrastructure for the Kouilou project. Work also continued on financing the project and, in 2001, the company entered into a financing framework agreement with Amphora Group Holding Luxembourg S.A., a European-based group. Under the Agreement, MagAlloy will form two Luxembourg-based companies, Magnesium Alloy Holding and Mag-Energy Holding. Amphora will secure a 75% interest in both companies in consideration of arranging funding to the companies of US$520 million and US$200 million, respectively. MagAlloy will hold a 25% interest in Magnesium Alloy Holding and a 20% interest in Mag-Energy Holding (5% will be held by third parties).

MagAlloy currently plans to begin production by 2005 at a rate of 60 000 t/y of magnesium metal and high-purity magnesium alloys. (MagAlloy has an Internet site at http://www.magnesiumalloy.ca.)

In 2000, the Congolese government announced a new mining and investment code that will offer incentives and guarantee security of tenure to mining companies to improve the investment climate by streamlining transfers of mineral rights and standardizing conditions on mining title. The government expected to release the code in 2001.

Australia

In late 2000, the Australian government started work on a Light Metals Industries Action Agenda to develop a strategic framework for the continued growth of sustainable and internationally competitive Australian light metals industries. Work will include an analysis and review of the industry. (Further information is available on the Internet at http://www.isr.gov.au/agendas/Sectors/LightMetals.)

Australian Magnesium Corporation (AMC), based in Brisbane, continued work on a proposed magnesium metal plant. As part of an earlier feasibility study, the company produced its first batch of magnesium metal ingots in August 1999 at a 1500-t/y pilot plant located near Gladstone, Queensland. During 2000, the company received government and environmental approvals for construction of the plant. Although financing activities under way at year-end were expected to be completed in early 2001, financing arrangements for the project had not been completed as of September 2001.

AMC's feasibility study, conducted by Fluor Australia Proprietary Ltd., which had a 5% interest in the project, was released in early 2000. It proposed an A$1.13 billion project to construct and commission a metal plant with a capacity of 90 000 t/y of primary magnesium metal in Stanwell, Queensland. Magnesite feed would be obtained from Queensland Metals Corporation Limited's (QMC) existing mining/magnesia production operations at the Kunwara magnesite deposit approximately 50 km north of Stanwell. (Additional information is available on the Internet at http://www.austmg.com.)

Capital costs for the plant were projected to be A$746 million with the remainder of the budget being used for commissioning and contingency costs. Operating costs were estimated to be US64¢/lb. The company expected to make a final decision on the commercial plant and to complete debt financing of the project in 2001. Construction of the plant was expected to be completed in 2004, full production was expected in 2006, and an expansion to 360 000 t/y was planned as markets allow.

The proposed magnesium metal plant would use a chlorine-based process using an Alcan electrolytic cell. The process was developed over the last 10 years by the Commonwealth Scientific and Industrial Research Organization (CSIRO) for Queensland Metals, which provided expertise and contributed A$7 million to the project. As a non-equity partner, it will receive a royalty from the company. Ford Motor Company invested US$30 million in the project in exchange for a 10-year agreement to purchase 45 000 t/y of magnesium metal. To mid-2001, AMC had spent A$200 million on the project.

In late 2000, the Australian government committed A$50 million to commercialize the process through CSIRO, and the Queensland government committed another A$50 million to provide infrastructure. AMC has now combined all of its research and development activity with CSIRO and that organization will continue research to develop new applications and improvements to the production technology. In 2001, the two levels of governments made commitments for an additional A$200 million to assist in the funding package.

A number of other companies in Australia continued developing magnesite resources or magnesium-rich mineral residues to produce magnesium metal, including: Samag Ltd.'s project in South Australia, Crest Magnesium NL's property in Tasmania, Golden Triangle Resources NL's project in Tasmania, Mt. Grace Resources NL's project in Northern Territory, and Anaconda Nickel Limited's project in Western Australia.

Samag Ltd. continued work on a proposed metal plant based on magnesite deposits located near Leigh Creek in the Willouran Ranges region of South Australia. Samag has increased the size of its initial proposal and now expects to construct an A$700 million, 65 000-t/y smelter using Dow technology. Cash operating costs are estimated at under US60¢/lb. The company expected construction to start in 2002 with metal production in 2004.

During 2000, the company:

- chose a site for the proposed metal plant at Weeroona, near Port Pirie in South Australia;
- signed a metal sales agreement with Thyssen Krupp Metallurgie GmbH for all of the metal production from the proposed Port Pirie plant;
- worked to obtain environmental permits and agreements with Aboriginal people at all of its sites;
- signed an agreement with Australian National Power to provide power and gas for the proposed magnesium plant using gas supplied by a new A$200 million pipeline from west Victoria to a proposed power plant near Port Pirie;
- received Major Project Status from the Commonwealth and State governments; and
- worked on a feasibility study for an additional magnesium metal plant in New Zealand but later abandoned the project (http://www.pima.com.au).

Indcor Limited (formerly Crest Magnesium NL) completed reorganization of the company, which has a proposed 60 000-t/y magnesium metal plant near Bell Bay, Tasmania. The project is based on a magnesite property in the Arthur and Lyons rivers area in northwestern Tasmania. A 1998 study conducted by BHP Engineering Pty indicated that a project could be commercially viable with operating costs of US65¢/lb using the company's rights to technology from the Ukrainian National Research and Design Titanium Institute and the Russian National Aluminium and Magnesium Institute (VAMI). Indcor has had discussions with a number of potential partners for joint operation or sale of the company's wholly owned Tasmanian magnesium project. (Indcor has an Internet site at http://www.indcor.com.au.)

Pacific Magnesium Corporation Ltd. (formerly Golden Triangle Resources NL) continued work on its Woodsreef magnesium project in New South Wales based on feed from asbestos tailings. A prefeasibility study of the Woodsreef project was completed that indicated costs of A$681 million for an 80 000-t/y operation with operating costs of A92¢/lb. The company carried out second-stage feasibility work and environmental assessment work, and has decided on a site for its proposed magnesium refinery in the Latrobe Valley of Victoria, Australia. Pacific Magnesium envisages that a plant could be completed in 2004. The company had optioned and conducted work on a magnesium deposit at Mains Creek, but has dropped that option.

Pacific Magnesium produced metal ingots from the tailings in a pilot plant operated by the Russian Titanium and Magnesium Institute in November 2000 and planed to proceed with a definitive feasibility study on the Woodsreef project that would be completed in late 2001. The company also held discussions with possible partners.

The Joint Israeli-Russian Laboratory for Energy Research, in Beer Sheva, Israel, has conducted research for the company on the use of MHD (magnetohydrodynamic) technology for magnesium purification. Such a process could provide faster cleaning rates than have previously been possible. (Additional information is available on the Internet at http://www.goldentriangle.com.au.)

Mt. Grace Resources NL continued work on its Northern Territory Batchelor magnesium project 85 km south of Darwin. The company has licensed technology developed by Mintek in South Africa for continuous thermal magnesium production technology (silico-thermic DC [direct current] arc furnace magnesium reduction) and participated in a project using a Mintek pilot plant to produce metal from the Batchelor magnesite in early 2001. The Mintek process has been developed over the last 10 years to produce metal in a DC arc furnace at atmospheric pressure.

In early 2001, Mt. Grace announced a contract for the first stage of its Definitive Feasibility Study. Results from this work indicated that an initial A$76 million plant with a 14-MW furnace could have a capacity of 12 500 t/y of metal. Once the plant is running, depending on market conditions, the company would expand the operation to 50 000 t/y in 2007. The company planned to complete a bankable feasibility study by the end of 2001 and has signed an agreement for the sale of 10 000 t/y of metal with the Frank & Schulte Group. a subsidiary of Stinnes Interfer, which is a division of Stinnes AG, one of Germany's largest companies. The company hoped to begin construction in 2002 with first production in 2003. (Mt. Grace has an Internet site at http://www.mtgrace.com.)

In mid-1999, Anaconda Nickel Limited announced that it was considering a large magnesium metal production plant (100 000 t/y). The project would be based on a magnesite deposit close to Murrin Murrin, a nickel-cobalt project near the Leonora/Laverton-Mount Margaret district. (Refer to the Nickel chapter for details on this latter project.) Anaconda Industries plans to develop three magnesite deposits near its nickel laterite deposits for the production of magnesia (to be used as a reagent at the Murrin Murrin nickel project) and has also further studied the magnesium metal project. (Anaconda has an Internet site at http://www.anaconda.com.au.)

OCCURRENCE

Magnesium is the eighth most abundant element, comprising over 2% of the earth's crust. It is the third most abundant element dissolved in seawater with a concentration averaging 0.14% by weight. Magnesium does not naturally occur in its native or metallic state, but is found in more than 60 different minerals. The principal magnesium minerals include carbonate forms in dolomite and magnesite; as a silicate in olivine and brucite; as an oxide/silicate in serpentine; and as a chloride in seawater, natural brines and evaporites. In the past, magnesium metal has been produced from dolomite/magnesite, seawater, brines, brucite and residues from asbestos mines. Companies have also looked at producing magnesium from other magnesium-rich sources of fly ash.

TECHNOLOGY

Magnesium metal is produced by a number of methods that can be classed into two general processes. These are: metallothermic, in which a reducing agent such as ferrosilicon is mixed with magnesium oxide and heated in a furnace under vacuum to produce magnesium metal vapour; and electrolytic, in which molten magnesium chloride salts are electrolyzed/reduced to produce liquid metal. Larger plants generally use electrolytic methods, which account for over one half of the world's production capacity. Metallothermic methods require more labour and are more suitable for small batch operations; these have become more important with the increased production from China.

USE

Although magnesium is consumed in some applications (such as in flares or when magnesium is used in chemical reactions in the production of other metals), most use in industrial and consumer products is generally non-destructive and the metal can be recycled and re-used. The energy inherent in the metal remains and the process of recycling the metal recovers that energy in a repeating and sustainable manner. Discussions on metals taking place in a number of fora indicate that word usage in reports such as this yearbook should be modified to more appropriately reflect actual practice.

Magnesium metal is best known for its light weight and high strength-to-weight ratio, making it suitable for a wide range of applications. When used as a structural material, magnesium is alloyed with other elements including aluminum, manganese, rare-earth metals, silver, thorium, zinc and zirconium. When alloyed with one or more of these elements, the resulting alloys can have unusually high strength-to-weight ratios. Magnesium-aluminum alloys are the most common and are principally used in die-casting applications.

The use of magnesium in larger-scale structural applications is relatively "new" and metal and alloy development for specific applications is not as advanced as for better-known metals such as iron. In addition, ways to avoid potential problems with corrosion are not as well developed for magnesium as for other metals such as iron and steel. As a result, some magnesium alloys have had limitations on their use due to the creep that can occur in higher-temperature environments and the potential for corrosion in some environments. However, work by various metal producers such as Noranda and Hydro Magnesium has resulted in new creep-resistant alloys for use in higher-temperature environments. Engineering data on their physical properties are being generated to allow increased use in larger-component automotive applications such as transmission housings, oil pans and engine blocks.

The main application of magnesium is in its use as an alloying agent for aluminum. According to the IMA, Western World magnesium shipments for this application increased by 2% to reach 45% of Western World shipments of primary magnesium (165 100 t) in 2000. Magnesium use for this application is dependent on growth of aluminum use and is expected to continue to increase by 2-3% annually.

The second largest use of magnesium is in high-pressure die-cast products, which can be used in structural applications such as equipment cases for electronics equipment or instrument panel beams of automobiles. The IMA reported that shipments of magnesium for die-cast applications were 110 000 t in 2000. This is lower than the 133 000 t reported in 1999, the difference in part due to a change in the method of calculating shipments from primary producers, which previously have included recycled magnesium. During the next decade, high-pressure die-casting is expected to be the fastest-growing application.

Many automobile manufacturers expect the use of die-cast magnesium parts will help them reduce total vehicle weight while meeting consumer demand for larger vehicles. The increased interest in magnesium metal in the automotive market is largely due to weight savings of more than 30% compared to aluminum and a desire to increase fuel efficiency through weight reduction. Stricter fuel efficiency and emissions standards are also encouraging many auto manufacturers to reduce their vehicles' weight.

Increased consumer demand for sport utility vehicles and cars with added luxury items is also driving manufacturers to find ways to reduce automobile curb weight through the use of cast magnesium instrument panel beams and a host of other smaller pieces on vehicles from transfer cases to steering column supports and cam shaft covers.

Magnesium has good vibration-dampening characteristics. Its lower heat of solidification, which increases die-casting production capacity by 25%, results in major process energy savings. Its characteristics also allow the casting of thinner and more complex shapes, which can replace a number of parts made with other materials, which in turn can also reduce the cost of assembly. Dies for magnesium castings are reported to have more than twice the life of aluminum dies and, at a magnesium-to-aluminum price ratio of about 1.7:1.0 or less, many magnesium metal parts can be fabricated at a lower cost than those made from aluminum. In this regard, over the last few years, the increased price of aluminum and the decreased price of magnesium have made the use of magnesium relatively more economical.

In addition to automotive applications, die-cast magnesium products are widely used in portable tools and sporting goods. The use of magnesium in electronics equipment, such as laptop computer housings and components, video cameras and cellular phones, has grown substantially. This trend is expected to continue. Magnesium's advantages for these applications are its good strength-to-weight ratio, heat dissipation, electromagnetic field containment, and radio frequency interference dissipation.

The third largest use of magnesium is as a desulphurizing agent in the ferrous industry where it is consumed in the production of steel and cast iron. Magnesium shipments in 2000 for desulphurization, as reported by the IMA, totaled 51 600 t, an increase of 23% from the 41 700 t shipped in 1999. Most of this increase is from shipments from lower-priced Chinese magnesium into this market, which has resulted in a higher rate of increase. Although this sector has grown at high rates in the past, should prices increase, growth in the future would be slower due to advances in desulphurization methods that use lower quantities of magnesium in making low-sulphur steels.

Magnesium is introduced into the melt during the production of nodular iron, which is used primarily for the production of ductile iron pipes and die-cast parts for use in automobiles and farm equipment. Shipments fell again in 2000 to 8800 t from 8900 t in 1999, a 1% decline, much less than the 27% decline a year earlier. This application is expected to continue to face stiff competition as plastics penetrate the water pipe market.

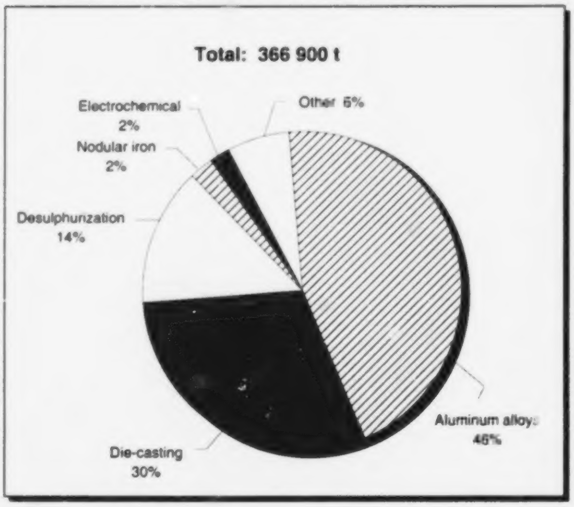
Electrochemical applications accounted for about 2% of magnesium shipments for use in the manufacture of batteries and in anodes for the cathodic protection of gas pipelines and water heaters. Chemical applications, with about 1.6% of shipments, include the manufacture of pharmaceutical products, perfumes and pyrotechnics. Wrought products, which accounted for about 1% of shipments, include extruded products except anodes, sheets and plates; gravity casting includes the production of complex or large parts by sand casting or casting with other materials. About 1% of magnesium shipments were used as a reducing agent in the production of titanium, beryllium, zirconium, hafnium and uranium.

Work continues on other ways of using magnesium and the lower prices prevalent during the year have stimulated further work. One potential use is in powder magnesium metal hydride storage systems for hydrogen for use in fuel cell-powered vehicles. Testing indicates such systems would hold more hydrogen per litre of volume than cryogenic systems. (Additional information is available on the Internet at http://www.ovonic.com.)

In Canada, the reported use of magnesium increased to 43 850 t in 1999 from 32 790 t in 1998 due to increases in reported use in castings and other uses. Previous growth in Canada's demand for magnesium has come from increased use in aluminum alloys and for castings and wrought products.

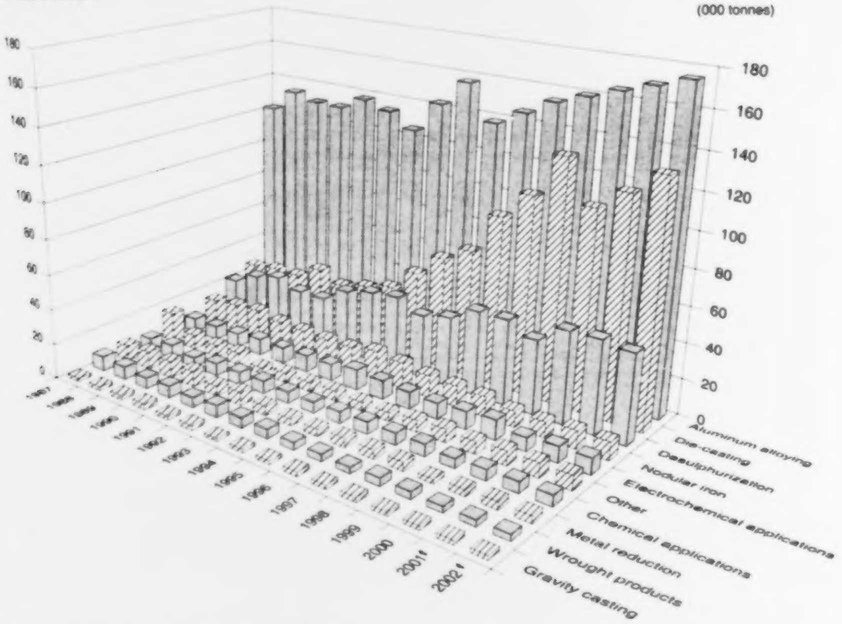
The biggest potential for growth in the use of magnesium lies in the aluminum alloy and automotive markets sectors. However, growth will be dependent on

Figure 5
Magnesium Shipments by Use, 2000



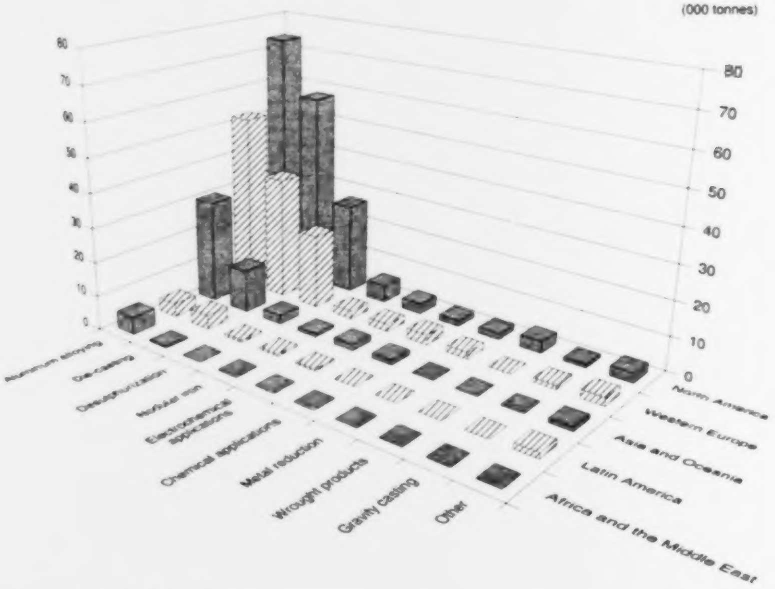
Source: International Magnesium Association.

Figure 6
Magnesium Shipments From Primary Producers, by Use, 1987-2002
2000 total: 366 900 t



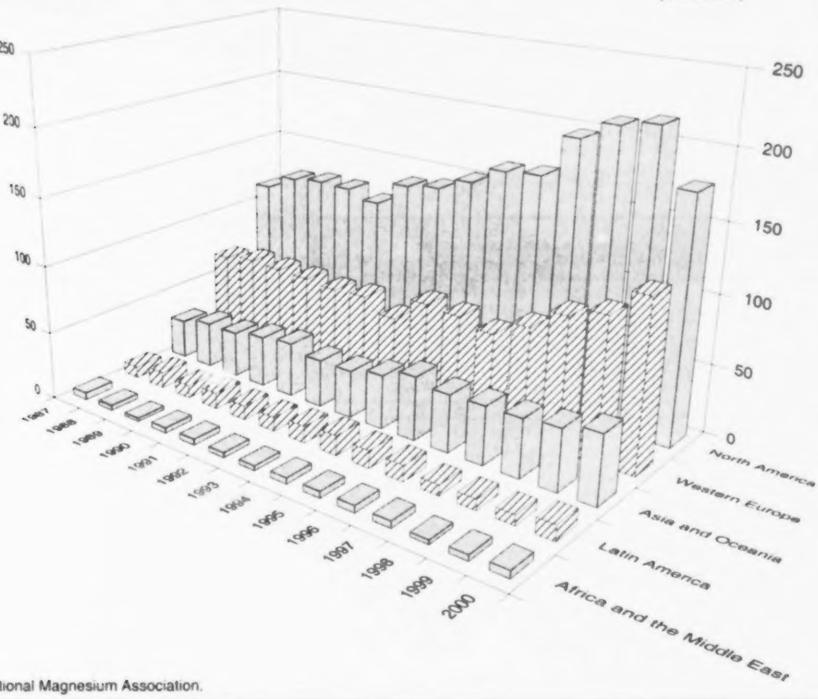
Sources: Natural Resources Canada; International Magnesium Association.
f Forecast.
Note: Die-casting does not use the total amount of material shipped. Shipment figures before 2000 may include recycled material; the die-casting figure for 2000 does not include this recycled material.

Figure 7
Primary Magnesium Shipments by Category and Area, 2000
2000 total: 366 900 t



Source: International Magnesium Association.

Figure 8
Primary Magnesium Shipments by Area, 1987-2000
2000 total: 366 900 t



Source: International Magnesium Association.

prices and price stability as magnesium continues to face stiff competition from other materials, including aluminum, steel and plastics, in the all-important automotive parts sector. New applications and increased awareness of the advantages of magnesium in certain applications are growing, particularly in the North American automotive industry.

RECYCLING

The production of recycled magnesium from metallic scrap requires about 5% of the energy required to produce primary magnesium. The recycling of old or post-consumer magnesium scrap is expected to increase with the anticipated growth in the use of magnesium die-cast automobile parts. In addition, casting operations produce a high proportion of new or process scrap in their operations that is recycled either on the site or at another location. Producers such as Norsk Hydro collect new magnesium scrap from their clients and recondition and recast the metal into a usable form and shape. This source of scrap is expected to increase with time as magnesium metal further penetrates the automotive and electronics markets and the vehicles and electrical equipment are scrapped. However, as technology and methods for recycling magnesium improve, it is likely that more recycling of producer and other clean new scrap will take place at casting operations. As figures are not collected on this run-around or new scrap, statistics on recycling magnesium may eventually show a decrease, although recycling would become more efficient.

Major North American auto manufacturers, including Chrysler, Ford Motor Company and General Motors Corporation, use magnesium alloy parts containing recycled magnesium. The recovery and use of this recycled magnesium reduces the cost of die-cast components and contributes to sustainable practices in metal use.

Several new magnesium recycling facilities and expansions of existing facilities were under way or announced during 2000 and early 2001. These include:

- Magnesium Elektron constructed its new 10 000-t/y magnesium recycling plant in Prague, in the **Czech Republic**, using scrap from Germany (http://www.luxfer.com and http://www.magnesium-elektron.com).

- Xstrata AG purchased technology from JCD Ltd. to convert magnesium scrap into high-purity recycled magnesium alloy and planned for the construction of a 25 000-t/y plant in Anderson, Indiana – its first scrap recycling facility in the mid-western **United States**.

- Remag Recycling GmbH purchased the equipment from closed **U.S.** magnesium recycler Alabama Cathodic Metals and planned to restart production in early 2001.
- Nippon Kinzoku Corp. completed construction of a 2400-t/y magnesium recycling plant in Kitakami Iwate prefecture in northern **Japan** and worked to commission the plant. The company expected to be operating at full capacity in early 2001. The company's recycling capacity in Japan will be 8000 t/y with this fourth plant.
- Hydro Magnesium and CS Aluminum discussed a joint venture for a magnesium alloy recycling plant in **Taiwan** that would refine alloy recycled die-casting magnesium to high-purity alloys.

STOCKS AND PRICES

According to the IMA, 2000 year-end inventories of members totaled 46 500 t, up 1% from 1999 year-end inventories of 45 900 t. This inventory represents about 46 days of shipments from primary magnesium producers.

Magnesium is neither traded on the London Metal Exchange nor is it traded on the New York Mercantile Exchange (NYMEX). The quantity of magnesium produced and used is lower than other metals used for industrial and structural purposes. For example, primary magnesium production is about 2% of primary aluminum production. As a result, markets for the metal are not well developed. In addition, due to the limited market, magnesium prices are sensitive to supply and demand in end-use markets. As a result, there is little transparency in the price or information on stockpiles of product. Many producers have direct sales contracts with large consumers, often on a long-term basis. Although prices depend on location, metal quality, and pricing differentials caused by duties and other factors, prices for primary magnesium for the year generally trended downward.

Prices published by *Metals Week* for magnesium trended down throughout the year. The U.S. Spot Western Mean started the year at US$1.45/lb, slipping to US$1.26/lb in December, while the mean U.S. dealer import prices decreased from US$1.25/lb early in the year to US$1.10/lb in December. The *Metal Bulletin*'s World Free Market Price for minimum 99.8% magnesium metal started the year at US$2400-$2500/t and declined steadily to end the year at US$1950-$2050/t.

Norsk Hydro's European producer price for pure magnesium started the year at 2.61 euros/kg. The company decreased the price of pure magnesium twice: it was set at 2.45 euros/kg in January, 2.33 euros/kg in April, and subsequently 2.22 euros/kg in January 2001. Norsk Hydro's price for alloy of 2.79 euros/kg established in early January 2000 was reduced to 2.62 euros/kg in January 2001.

Reported prices of Chinese magnesium on a spot basis f.o.b. China remained at approximately US$1500/t throughout 2000, although prices have weakened further in 2001.

OUTLOOK

World primary magnesium production is expected to be about 500 000 t in 2001. With increasing use in die-casting and intensity of use, particularly in automotive applications, magnesium use, especially in the die-casting areas, should continue to grow in the medium to long term.

Canadian production of magnesium increased dramatically at the start of the decade with the opening of Norsk Hydro's 43 000-t/y Bécancour smelter in 1989. Canada's installed primary magnesium production capacity has since remained stable, but it is set to rise again with the ramp-up of Magnola Metallurgy's 58 000-t/y plant at Danville, Quebec. Once completed, Canadian primary magnesium production capacity will rise to about 110 000 t/y.

The amount of magnesium used in automotive applications is relatively low compared to the use of other materials. Although some models contain larger quantities of magnesium, the average vehicle has been estimated to contain approximately 4.5 kg of magnesium, while the plastic content is estimated at over 100 kg. As a result, a relatively minor increase in magnesium used in automotive parts could result in a large increase in magnesium use overall.

Another major factor that will influence magnesium prices in the longer term will be the change in supply over the next decade as the result of expansions/re-openings of existing capacity, or the opening of new plants in China, Canada, Australia, Iceland and the Middle East in the near and medium term. The tonnages of metal that would be produced in these plants, should they become operational and remain economic, is impressive and would more than double current total global production. This potential increase in production continues to present both opportunities and challenges to existing producers while presenting new opportunities to large consumers.

The forecasting of magnesium prices is complicated at this time due to relatively rapid changes that are occurring in production levels, the opening and closings of plants, new and potential applications for use, and the imposition of duties. It is likely, however, that prices will remain weak and potentially volatile on a short-term basis until new widespread transportation uses increase demand. On the other hand, the use of magnesium in the all-important automotive sector is dependent on prices being competitive with other materials.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of March 30, 2001. (3) Some differences are noted in some data from independent sources. Work is under way to determine the reasons for these differences. (4) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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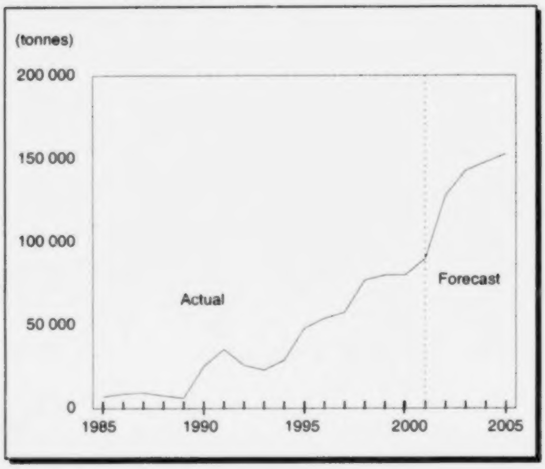
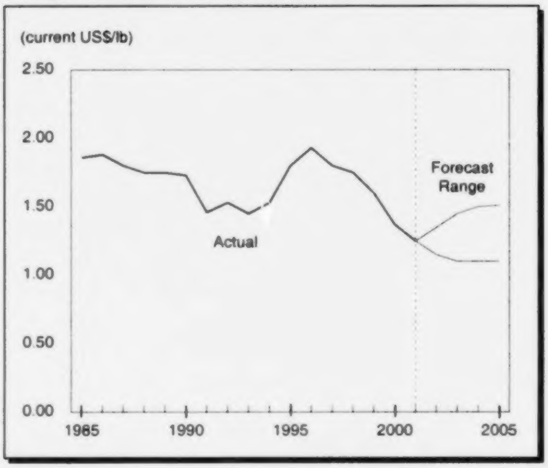
Figure 9
Canadian Magnesium Production, 1985-2005



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
Notes: Canadian production data are confidential. Estimated data from the International Consultative Group on Nonferrous Metal Statistics includes recycled material.

Figure 10
Magnesium Prices, 1985-2005



Source: *Metals Week* (U.S. Spot Western Mean).

TARIFFS[1]

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States[2] Canada	EU[2] MFN	Japan[3] WTO
8104.11	Magnesium unwrought, containing by weight at least 99.8% of magnesium	2.5%	Free	Free	Free	5.3%	Free-3%
8104.19	Magnesium unwrought, other						
8104.19.10	Magnesium-rare earth, magnesium-didymium, magnesium-thorium, magnesium-zirconium and magnesium-thorium-neodymium-rare earth for use in the manufacture of magnesium castings	Free	Free	Free	Free	4%	Free-3%
8104.19.90	Other	2.5%	Free	Free	Free	4%	Free-3%
8104.20	Magnesium waste and scrap	Free	Free	Free	Free	Free	2.1%
8104.30	Magnesium raspings, turnings and granules, graded according to size; powders	2.5%	Free	Free	Free	4%	3%
8104.90	Other magnesium	2.5%	Free	Free	Free	4%	3%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (40th Annual Edition: 2000); *Custom Tariff Schedules of Japan*, 2000.

[1] Does not include countervail or anti-dumping duties, which may be applied to material of certain origin. [2] Duty suspension may apply for certain goods.
[3] WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITY AND COUNTRY, 1999 AND 2000

Item No.		1999		2000^p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	United States	3 916	19 940	3 098	15 047
	Germany	1 492	5 817	1 783	6 467
	Japan	874	4 125	1 368	5 350
	Austria	684	2 258	1 190	4 003
	United Kingdom	238	1 798	331	2 292
	Other countries	731	3 391	362	1 281
	Total	7 935	37 329	8 132	34 440
8104.19	Magnesium unwrought, other				
	United States	28 841	145 503	21 273	105 641
	Norway	29	122	779	2 693
	Netherlands	280	1 971	226	1 243
	Australia	280^r	1 852^r	140	852
	United Kingdom	131	920	92	627
	Other countries	832^r	2 825^r	514	2 087
	Total	30 393^r	153 193^r	23 024	113 143
8104.20	Magnesium waste and scrap				
	United States	2 152	4 665	6 450	19 316
	Norway	3 361	6 907	562	1 798
	Other countries	99	326	76	184
	Total	5 612	11 898	7 088	21 298
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	5 236	19 261	5 993	17 943
	Ireland	232^r	1 799^r	231	1 794
	South Korea	138	760	310	1 712
	Other countries	106	905	264	2 104
	Total	5 712^r	22 725^r	6 798	23 553
8104.90	Magnesium and articles thereof, other				
	United States	84	625	1 842	10 439
	Australia	–	–	182	1 076
	Other countries	11	150	89	664
	Total	95	775	2 113	12 179
	Total exports	49 747^r	225 920^r	47 155	204 613
IMPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	Russia	193	706	4 030	15 015
	United States	806^r	4 018^r	2 738	11 421
	China	3 498^r	10 194^r	3 763	8 782
	Israel	1 634	7 722	747	3 110
	Brazil	241	982	719	2 818
	Other countries	2 299^r	10 912^r	593	2 175
	Total	8 671^r	34 534^r	12 590	43 321
8104.19	Magnesium unwrought, other				
	United States	1 472^r	7 100^r	4 476	21 989
	Norway	2 977^r	14 100^r	3 173	13 833
	China	2 954	9 435	2 171	9 878
	France	1 155	3 435^r	639	2 794
	United Kingdom	103	1 390	181	2 273
	Other countries	846	3 708	295	1 275
	Total	9 507^r	39 168^r	10 935	52 042
8104.20	Magnesium waste and scrap				
	United States	16 798^r	67 015^r	6 860	24 758
	Russia	184	200	717	3 157
	Other countries	–	–	1 187	3 363
	Total	16 982^r	67 215^r	8 764	31 278
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	350	1 565	474	2 217
	Switzerland	42	171	21	80
	Other countries	69^r	288^r	17	70
	Total	461^r	2 024^r	512	2 367
8104.90	Magnesium and articles thereof, other				
	United States	2 232^r	11 989^r	960	9 010
	China	2	60	53	338
	Other countries	35	300	21	165
	Total	2 269^r	12 349^r	1 034	9 513
	Total imports	37 890^r	155 290^r	33 835	138 521

Source: Statistics Canada.
– Nil; ^{p} Preliminary; ^{r} Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, MAGNESIUM USE,[1] 1993-99

	1993[■]	1994	1995[■]	1996	1997	1998	1999[■,p]
				(tonnes)			
Castings and wrought products[2]	7 678	8 940	12 488	11 197	16 795	16 687	27 383
Aluminum alloys	10 174	12 389	12 323	14 022	14 793	13 417	13 741
Other uses[3]	2 162	2 234	2 329	2 357	2 438	2 459	1 520
Total	20 014	23 563	27 140	27 576	34 026	32 563	42 643

Source: Natural Resources Canada.
[p] Preliminary.
[■] Increase in number of companies being surveyed.
[1] Available data as reported by users. [2] Die, permanent mould and sand castings, structural shapes, tubings, forgings, sheet and plate. [3] Cathodic protection, reducing agents, deoxidizers and other alloys.
Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD PRODUCTION OF MAGNESIUM, 1994-2000

Country	Rank in 2000	1994	1995	1996	1997	1998	1999	2000[●]
					(000 tonnes)			
PRIMARY PRODUCTION								
China[2]	1	11.0	93.6[r]	73.2[r]	76.0[r]	70.5	120.7	165.0
United States	2	128.5	142.1	133.1	124.8	106.1	75.0	70.0
Canada[1,●]	3	28.9	48.1	54.0	57.7	77.1	71.0	75.0
Norway	4	27.6	28.0	37.8	34.2	35.4	40.8	40.0
Russia	5	35.4	37.5	31.5[r]	33.0[r]	34.1[r]	35.2	35.0
Israel	6	–	–	–	7.4[r]	24.5[r]	30.0	35.0
Kazakhstan	7	3.0	9.0	13.4	17.9[r]	20.9[r]	21.2	21.0
France	8	12.3	14.5	14.0	13.8	14.7	15.0	15.0
Brazil	9	8.8	9.7	9.0	9.0	9.0	9.0	9.0
India	10	1.0	1.0	1.0	1.0	1.5	1.5	1.5
Serbia & Montenegro	11	–	2.6	3.1	3.9[r]	4.0[r]	1.2	1.0
Ukraine	12	12.0	13.0	12.9	7.7	5.0	–	–
Japan	13	3.4	–	–	–	–	–	–
Total primary		271.9	399.1[r]	383.0[r]	386.4[r]	402.8[r]	420.6	467.5
RECYCLED PRODUCTION[3]								
United States	1	62.1	65.1	71.2[r]	77.6	77.1[r]	87.3	90.0
Japan	2	19.0	11.8	21.2	22.8	20.0	20.0	24.0
United Kingdom	3	0.5	0.5	0.5	0.5	0.5	1.0	2.0
Brazil	4	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Austria	5	0.1	0.1	–	–	–	–	–
Total secondary		83.3	79.1	94.5[r]	102.5	92.2[r]	109.9	117.6
Total production		355.2	478.2[r]	477.5[r]	488.9[r]	502.0[r]	530.5	585.1

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; industry publications.
– Nil; [●] Estimated; [p] Preliminary; [r] Revised.
[1] Estimate per USGS, includes secondary. [2] Numbers used in table from International Consultative Group on Nonferrous Metal Statistics. China Magnesium Association reports higher numbers for Chinese production: 1994 - 25 000 t; 1997 - 92 000 t; 1998 - 120 000 t; 1999 - 157 000 t; 2000 - 194 000 t. [3] Recycled magnesium facilities exist in other locations, including Canada, which have not reported separate production figures for recycled magnesium due to confidentiality reasons and other considerations.

TABLE 4. WORLD USE OF MAGNESIUM, 1995-2000

Country	Rank in 1999	1995	1996	1997	1998	1999	2000•
				(000 tonnes)			
PRIMARY PRODUCTION							
United States	1	174.0	172.9	171.9	171.9	170.9	. .
Japan	2	44.9	52.5	52.5	50.9	54.6	. .
Canada•	3	27.1	27.6	34.0	32.6	42.6	51.8
Russia	4	25.0	25.0	25.0	25.0	25.0	. .
France	5	17.0	18.7	20.1	20.0	20.0	. .
Germany	6	19.9	19.6	21.9	20.0	15.2	. .
China	7	22.0	22.0	22.0	22.0	11.1	. .
Italy	8	5.4	6.2	9.3	9.0	10.7	. .
Venezuela	9	10.0^{r}	10.0^{r}	10.0^{r}	10.0	10.0	. .
Brazil	10	10.0	10.0	10.0	10.0	9.7	. .
Norway•	11	6.0	6.0	6.0	6.0	6.0	. .
South Korea	12	2.0	3.1	3.6	3.5	5.5	. .
United Kingdom	13	6.0	5.2	4.9	5.1	5.3	. .
Switzerland	14	2.1	2.4	3.3	3.5	4.8	. .
Taiwan	15	3.0	1.7	2.9	3.0	4.4	. .
Australia•	16	4.0	4.0	4.0	4.0	4.0	. .
Spain	17	1.5	1.5	2.3	2.5	3.1	. .
Belgium/Luxembourg	18	4.0	1.3	5.1	3.0	2.8	. .
South Africa	19	0.8	2.5^{r}	2.5^{r}	2.5	2.5	. .
Austria	20	3.5	1.6	2.2	2.0	2.0	. .
India	21	1.8	1.8	1.8	1.8	1.8	. .
Other Asia	22	1.7	1.7	1.7	1.7	1.7	. .
Sweden	23	2.2	1.7	1.6	1.5	1.2	. .
Netherlands	24	1.2	1.2	1.2	1.2	1.2	. .
Egypt•	25	1.2	1.0	1.0	1.0	1.0	. .
Mexico	26	1.0	1.0	1.0	1.0	1.0	. .
New Zealand•	27	1.0^{r}	1.0^{r}	1.0^{r}	1.0	1.0	. .
Greece	28	0.1	0.1	0.1	0.1	0.9	. .
Argentina	29	0.4	0.4	0.4	0.4	0.9	. .
Poland	30	0.7	0.8	0.8	0.8	0.8	. .
Turkey	31	1.5	0.5	0.5	0.5	0.5	. .
Czech Republic	32	0.3	0.3	0.3	0.3	0.3	. .
Romania	33	0.3	0.3	0.3^{r}	0.3	0.3	. .
Other America	34	0.2	0.2	0.2	0.2	0.2	. .
Hungary	35	0.2	0.2	0.2	0.2	0.2	. .
Former Yugoslavia	36	0.2	0.2	0.2	0.2	0.2	. .
Cameroon	37	0.1	0.1	0.1	0.1	0.1	. .
Ghana	38	0.1	0.1	0.1	0.1	0.1	. .
Other Europe	39	0.1	0.1	0.1	0.1	0.1	. .
Denmark	40	0.2	0.2	0.2	0.2	0.1	. .
Total primary		402.7^{r}	406.7^{r}	426.3^{r}	419.2	423.8	. .
% Change from previous year		9.4%	1.0%	4.8%	-1.7%	1.1%	. .

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
. . Not available at time of writing; • Estimated; ^{r} Revised.

Mineral Aggregates

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Total Canadian shipments of regular weight mineral aggregates in 2000 have been estimated to be 351 Mt, based on preliminary data, compared to 345 Mt in 1999, based on final data. Specifically, these data relate to the combined amounts of crushed stone and miscellaneous stone, and sand and gravel, essentially all for construction uses (Table 1, By Use, and Table 2, respectively). Relevant subtotals of shipments of crushed stone and miscellaneous stone by rock type, e.g., limestone, granite and other types of stone, are included in a separate commodity chapter entitled *Stone*.

Increased demand for construction aggregates is expected in 2001 based on growth in the residential and non-residential construction sectors. The average unit values of construction aggregates shipped, as reported by producers, generally continued to increase in pace with the rate of inflation with selling prices varying considerably depending on proximity to consumers.

In follow-up to the Canada Infrastructure Works from 1994 to 1999, a new six-year Infrastructure Canada Program to enhance physical infrastructure has been introduced beginning in the fiscal year 2000/01. This cost-shared program is expected to contribute about $6 billion to construction spending and to be supported by all three levels of government.

Trade in construction aggregates, mainly with the United States, is particularly important in Atlantic Canada and in British Columbia. It is expected that the U.S. *Transportation Equity Act for the 21st Century*, which will have appropriated a total of about US$200 billion during the planned five-year period through 2003, may result in additional export opportunities for strategically located producers in Canada.

Information on lightweight aggregates, including ferrous slags, is included in Tables 6-11, inclusive.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of February 1, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. CANADA, TOTAL PRODUCTION OF STONE, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY[1]						
Newfoundland	2 606	19 837	3 091	20 206	4 938	29 095
Nova Scotia	7 628	45 348	7 881	48 064	7 951	46 328
New Brunswick	3 500	20 796	4 388	23 141	3 436	19 212
Quebec	32 220	215 171	30 269	218 744	29 375	215 234
Ontario	50 689	344 707	51 258	385 675	55 204	434 935
Manitoba	4 992	24 971	4 314	20 089	4 357	20 342
Alberta	633	5 362	465	4 623	431	4 752
British Columbia	6 321	46 995	7 440	54 505	6 473	49 180
Northwest Territories	336	4 760	78	452	184	2 848
Total	108 924	727 947	109 184	775 499	112 348	821 926
BY USE[2]						
Stone (Dimension)						
Dimension stone						
Rough	302	34 100	315	41 031	. .	. .
Monumental and ornamental stone (n.f.)	68	5 691	88	7 939	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	66	8 668	104	13 550	. .	. .
Total dimension stone	436	48 459	507	62 520	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	17 537	99 721	20 718	122 299	. .	. .
Asphalt aggregate	10 398	63 791	11 097	69 608	. .	. .
Road metal	31 135	165 001	30 663	165 040	. .	. .
Railroad ballast (includes traprock)	2 187	16 668	1 830	15 437	. .	. .
Other uses	35 318	181 157	34 873	181 907	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 334	46 555	14 082	50 085	. .	. .
Cement plants, foreign	1 632	7 973	525	1 919	. .	. .
Flux in iron and steel furnaces	3 406	21 830	1 295	10 476	. .	. .
Flux in nonferrous smelters	129	900	101	818	. .	. .
Glass factories	203	3 635	163	2 739	. .	. .
Lime plants, Canada	3 353	18 558	5 261	19 877	. .	. .
Lime plants, foreign	216	1 843	1 229	6 269	. .	. .
Pulp and paper mills	89	1 046	96	1 120	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 748	11 787	1 550	9 360	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	10	395	3	120	. .	. .
Roofing granules	580	25 388	751	27 309	. .	. .
Poultry grit	188	2 080	176	1 775	. .	. .
Stucco dash	25	3 598	25	2 682	. .	. .
Terrazzo chips	4	153	7	303	. .	. .
Rock wool	14	214	26	424	. .	. .
Rubble and riprap	1 415	8 147	942	4 415	. .	. .
Other uses	944	8 350	1 090	8 506	. .	. .
Pulverized stone						
Whiting	48	3 631	274	9 956	. .	. .
Asphalt filler	175	261	178	247	. .	. .
Dusting coal mines	3	219	2	145	. .	. .
Agricultural purposes and fertilizer plants	1 169	17 914	1 049	15 377	. .	. .
Other uses	806	37 892	897	58 632	. .	. .
Total crushed stone	127 066	748 708	128 903	786 848		
Total all stone	127 502	797 167	129 410	849 368	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; p Preliminary.
[1] Data exclude stone used in the Canadian cement, lime and clay industries. [2] Data include stone used in the Canadian cement, lime and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, PRODUCTION OF SAND AND GRAVEL,[1] BY PROVINCE AND TERRITORY, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Newfoundland	3 714	17 764	2 836	7 305	2 837	7 043
Prince Edward Island	199	898	257	1 258	244	1 144
Nova Scotia	2 400	10 927	2 250	10 605	2 408	11 303
New Brunswick	4 336	x	4 492	13 190	3 721	11 721
Quebec	27 319	72 414	30 274	83 473	25 405	82 774
Ontario	88 186	325 109	105 714	408 321	115 478	413 459
Manitoba	10 135	x	10 428	29 989	9 158	26 785
Saskatchewan	12 032	x	11 094	37 865	10 960	34 098
Alberta	43 998	200 823	41 229	195 630	41 525	196 580
British Columbia	31 908	161 084	32 615	164 019	32 915	163 422
Yukon	690	2 123	807	2 105	1 142	3 075
Northwest Territories	419	2 009	374	4 453	539	4 805
Nunavut	–	–	–	–	–	–
Total	225 338	875 226	242 369	958 215	246 331	956 209

Source: Natural Resources Canada.
– Nil; p Preliminary; x Confidential.
[1] Production represents shipments of natural gravel, sand and crushed gravel. Does not include shipments to Canadian cement plants.
Note: Numbers may not add to totals due to rounding.

TABLE 3. AVAILABLE DATA ON USE OF SAND AND GRAVEL, BY REGION, 1998 AND 1999

	Year	Atlantic Provinces	Quebec	Ontario	Western Provinces[1]	Canada
				(000 tonnes)		
Road bed, surface	1998	5 778	16 351	40 193	46 601	108 923
	1999	4 210	18 097	42 086	47 324	111 717
Roads, ice control	1998	476	716	2 713	3 768	7 672
	1999	655	672	3 024	2 107	6 458
Concrete aggregate	1998	1 514	2 668	13 997	17 301	35 479
	1999	1 769	3 477	13 030	16 180	34 457
Asphalt aggregate	1998	886	2 570	7 904	10 071	21 430
	1999	634	2 648	8 154	10 021	21 457
Railroad ballast	1998	38	1	5	177	221
	1999	22	19	4	210	255
Mortar sand	1998	40	283	1 091	284	1 698
	1999	42	206	1 367	239	1 853
Backfill for mines	1998	. . .	32	1 188	791	2 011
	1999	286	21	1 244	249	1 801
Fill	1998	884	2 446	9 301	7 397	20 027
	1999	1 409	2 970	11 429	7 173	22 981
Other purposes	1998	1 076	2 253	12 304	13 028	28 661
	1999	853	2 165	25 770	13 246	42 034
Total	1998	10 690	27 319	88 694	99 418	226 122
	1999	9 880	30 274	106 109	96 751	243 013

Source: Natural Resources Canada.
. . . Amount too small to be expressed.
[1] The western provinces include the Yukon and Northwest Territories.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, EXPORTS AND IMPORTS OF SAND AND GRAVEL AND CRUSHED STONE, 1998-2000

Item No.		1998		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	333 040	3 735	452 415	5 060	456 377	4 736
	Bahamas	21 009	548	41 220	968	61 811	1 258
	Venezuela	75	40	427	156	455	99
	Argentina	–	–	–	–	313	67
	Trinidad and Tobago	–	–	101	16	202	33
	Philippines	–	–	–	–	201	30
	Thailand	11 594	116	–	–	–	–
	Chile	25	5	56	17	–	–
	Bermuda	7 691	76	16 066	153	–	–
	Mexico	152	47	76	24	–	–
	Saint Pierre and Miquelon	–	–	30	10	–	–
	Iceland	–	–	4 313	285	–	–
	Malaysia	–	–	39	14	–	–
	Barbados	–	–	53 538	1 719	–	–
	Total	373 586	4 567	568 281	8 422	519 359	6 223
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	3 075 787	27 522	3 287 916	33 381	3 129 470	31 706
	Panama	–	–	–	–	536 580	1 258
	Bahamas	34 021	727	45 865	1 103	47 239	1 079
	Jamaica	–	–	–	–	44 631	931
	Bermuda	25 927	462	4 743	50	18 965	191
	Japan	–	–	–	–	6	47
	France	12	25	–	–	–	–
	India	14 700	86	–	–	–	–
	Guyana	19 181	231	–	–	–	–
	Suriname	32 620	414	–	–	–	–
	Germany	–	–	57	1	–	–
	Iceland	–	–	3 715	243	–	–
	Barbados	–	–	15 832	467	–	–
	Total	3 202 248	29 467	3 358 128	35 245	3 776 891	35 212
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	244 565	27 251	267 109	37 943	347 873	56 015
	France	8	24	85	15	–	–
	Total	244 573	27 275	267 194	37 958	347 873	56 015
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated or not						
	United States	1 638	158	1 427	118	100 810	6 089
	Barbados	–	–	39 711	1 011	–	–
	Other countries	94	48	17	10	43	14
	Total	1 732	206	41 155	1 139	100 853	6 103
2518.10	Dolomite, not calcined						
	United States	967 762	9 075	2 082 332	21 650	2 800 364	28 836
	Venezuela	–	–	75 889	1 034	396 323	4 101
	Mexico	–	–	227 070	2 022	311 456	2 771
	Trinidad and Tobago	–	–	–	–	109 469	1 976
	Brazil	–	–	–	–	26 445	161
	Romania	–	–	5	94	73	14
	Total	967 762	9 075	2 385 296	24 800	3 644 130	37 859
2518.20	Calcined dolomite						
	United States	32 515	6 459	29 466	6 696	15 749	4 112
	India	–	–	110	30	–	–
	Total	32 515	6 459	29 576	6 726	15 749	4 112
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	2 761 101	21 515	2 521 646	16 487	2 856 799	18 632
	Mexico	–	–	–	–	35 322	293
	Australia	20	15	–	–	–	–
	Total	2 761 121	21 530	2 521 646	16 487	2 892 121	18 925
IMPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	310 580	8 402	301 864	7 981	321 577	9 105
	China	11	. . .	160	44	488	126
	Philippines	111	42	533	35	239	51
	United Kingdom	2 632	58	1 320	46	168	41
	South Africa	2	. . .	1	. . .	171	30
	Taiwan	1	. . .	5	. . .	429	29
	India	414	66	618	99	169	26
	Netherlands	–	–	–	–	1 809	17
	Other countries	768	120	357	45	308	49
	Total	314 519	8 688	304 858	8 250	325 358	9 474

TABLE 4 (cont'd)

Item No.		1998		1999		2000^{p}	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	3 188 068	18 688	3 174 168	17 719	3 083 383	16 860
	China	16 077	141	7 674	73	8 976	137
	Israel	–	–	–	–	18 364	74
	United Kingdom	461	28	1 316	49	695	67
	Netherlands	–	–	10	. . .	5 361	50
	Philippines	1 508	18	1 035	12	2 527	48
	Belgium	351	4	453	4	578	26
	France	1 390	9	1 578	14	1 979	20
	Mexico	823	10	836	7	1 090	13
	Portugal	–	–	–	–	1 139	6
	Other countries	326	11	1 028	9	1 276	14
	Total	3 209 004	18 909	3 188 098	17 887	3 125 368	17 315
2517.20	Macadam of slag, dross or similar industrial waste, etc.						
	United States	5 746	45	5 209	34	30 028	228
	Other countries	133	1	317	2	1 464	11
	Total	5 879	46	5 526	36	31 492	239
2517.30	Tarred macadam						
	United States	1 149	47	119	6	158	7
	Total	1 149	47	119	6	158	7
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	103 938	17 120	88 377	15 207	58 870	10 384
	Italy	51	11	155	25	187	22
	France	181	38	96	16	63	10
	Other countries	8	1	16	2	33	8
	Total	104 178	17 170	88 644	15 250	59 153	10 424
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated or not						
	United States	38 491	1 588	25 852	1 324	28 466	1 613
	Brazil	104	10	191	23	476	33
	India	–	–	–	–	374	28
	France	570	68	109	10	210	25
	China	28	1	58	6	105	11
	Greece	1 334	72	–	–	8	. . .
	Other countries	56	5	359	36	305	14
	Total	40 583	1 744	26 569	1 399	29 944	1 724
2518.10	Dolomite, not calcined						
	United States	2 635	499	3 329	659	4 784	866
	Other countries	10	2	20	7	82	22
	Total	2 645	501	3 349	666	4 866	888
2518.20	Calcined dolomite						
	United States	2 946	584	3 078	615	3 810	761
	Other countries	143	13	756	86	320	35
	Total	3 089	597	3 834	701	4 130	796
2518.30	Agglomerated dolomite (including tarred dolomite)						
	United States	100	28	159	44	556	181
	Other countries	–	–	–	–	103	37
	Total	100	28	159	44	659	218
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	3 858 730	17 619	4 140 503	18 286	4 027 510	17 810
	Italy	–	–	196	1	98 963	459
	France	–	–	4 077	15	57 466	70
	Portugal	300	1	–	–	14 835	53
	Turkey	–	–	–	–	3 144	15
	Mexico	6 652	17	4 043	14	2 622	10
	Tunisia	–	–	–	–	2 987	10
	Other countries	4 156	11	7 948	34	1 692	6
	Total	3 869 838	17 648	4 156 767	18 350	4 209 219	18 433

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; ^{p} Preliminary; ^{r} Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 5. LIGHTWEIGHT AGGREGATE PRODUCERS IN CANADA, 1999

Company	Location	Commodity	Remarks
ATLANTIC PROVINCES			
Fafard Peat Moss Company Ltd.	Inkerman, N.B.	Perlite, vermiculite	Processed for use in horticulture.
Sun Gro Horticulture Canada Ltd.	Lamèque, N.B.	Perlite	Processed for use in horticulture.
QUEBEC			
Premier Horticulture	Rivière-du-Loup	Perlite, vermiculite	Processed for use in horticulture.
Vermi-Lite Inc., subsidiary of Perlite Canada Inc.	Baie-du-Febvre	Perlite, vermiculite	Processed for use in horticulture.
ONTARIO			
Grace Canada, Inc.	Ajax	Vermiculite, perlite	Vermiculite processed for use in horticulture, as loose insulation, and in friction materials. Perlite processed for use in gypsum plaster, horticulture, refractories and as loose insulation.
Lafarge Canada Inc., Hamilton Slag Division	Hamilton	Slag	Used in concrete products industry.
V.I.L. Vermiculite Inc.	Woodbridge Lachine, Que. (plant)	Vermiculite, perlite	Vermiculite processed for use in loose insulation, horticulture and concrete products. Perlite processed for use in horticulture.
PRAIRIE PROVINCES			
Cindercrete Products Ltd.	Saskatoon, Sask.	Expanded clay	Processed for concrete products industry.
Grace Canada, Inc.	Winnipeg, Man.	Vermiculite, perlite	Perlite processed for use in gypsum plaster, loose insulation and in horticulture.
	Edmonton, Alta.	Vermiculite, perlite	Vermiculite processed for use in horticulture and in fricton material and as loose insulation.
Inland Cement Limited	Calgary, Alta.	Expanded shale	Processed for concrete products industry and for loose insulation.
	Edmonton, Alta.	Expanded clay	Processed for concrete products industry, and for loose insulation.
Sun Gro Horticulture Canada Ltd.	Elma, Man.	Perlite	Processed for use in horticulture.
	Seba Beach, Alta.	Perlite, pumice	Processed for use in horticulture.
BRITISH COLUMBIA			
Canada Pumice Corporation	Nakzo, Quesnel	Pumice	A range of pumice products for construction and landscaping material.
Great Pacific Pumice Inc.	Mt. Meager	Pumice	Used in horticulture, concrete products industry and as fill.
Ocean Construction Supplies Limited	Vancouver	Pumice	Purchased for concrete products industry.

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."

TABLE 6. CANADA, IMPORTS AND EXPORTS OF VERMICULITE, PERLITE AND PUMICE, 1998-2000

Item No.		1998		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	443	76	–	–	–	–
	Total	443	76	–	–	–	–
2530.10	Vermiculite, perlite and chlorites, unexpanded						
	United States	. .	75	. .	49	. .	17
	Chile	–	–	. .	6	. .	8
	Netherlands	–	–	. .	21	–	–
	Total	. .	75	. .	76	. .	25
IMPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	4 841	756	4 807	782	4 985	804
	Turkey	3 450	528	3 877	504	5 298	684
	Greece	337	94	117	16	93	14
	Other countries	435	89	42	9	56	12
	Total	9 063	1 467	8 843	1 311	10 432	1 514
2513.19	Pumice stone, other						
	United States	2 816	578	2 861	600	3 806	675
	Other countries	574	117	861	181	816	204
	Total	3 390	695	3 722	781	4 622	879
2530.10.00.10	Vermiculite, unexpanded						
	United States	10 894	1 806	13 196	2 445	16 532	2 918
	South Africa	12 293	3 110	18 628	4 749	11 115	2 663
	Cayman Islands	–	–	475	101	1 044	195
	Greece	3 518	333	1 792	227	181	21
	Other countries	60	12	1 515	226	22	7
	Total	26 765	5 261	35 606	7 748	28 894	5 804
2530.10.00.20	Perlite, unexpanded						
	United States	27 157	5 058	33 955	6 435	27 854	4 961
	Greece	17 094	2 037	23 915	2 632	20 974	2 554
	Other countries	3	–	–	–	24	10
	Total	44 254	7 095	57 870	9 067	48 852	7 525
3802.90.00.20	Activated perlite, excluding expanded perlite ground to be employed in filtering						
	United States	413	219	438	218	503	288
	Total	413	219	438	218	503	288
6806.20.00.10	Exfoliated (expanded) vermiculite						
	United States	326	1 237	487	1 873	449	1 619
	Other countires	2	5	23	53	1	4
	Total	328	1 242	510	1 926	450	1 623
6806.20.00.20	Expanded perlite						
	United States	9 012	5 892	8 383	5 933	9 636	6 766
	Other countries	13	9	–	–	9	4
	Total	9 025	5 901	8 383	5 933	9 645	6 770

Source: Statistics Canada.
– Nil; . . Not available; p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, LIGHTWEIGHT AGGREGATES PRODUCED, SOLD AND USED, 1998 AND 1999

	1998				1999			
	Produced		Sold and Used		Produced		Sold and Used	
	(m³)	($)	(m³)	($)	(m³)	($)	(m³)	($)
From domestic and/or imported raw materials								
Expanded clay, shale and slag[1]	192 636	6 117 329	195 718	6 579 311	391 352	11 192 017	371 934	10 168 975
From imported crude materials								
Expanded perlite and exfoliated vermiculite[1]	569 204	29 904 132	611 318	32 098 810	658 770	35 304 186	662 770	35 548 186
Total	761 840	36 021 461	807 036	38 678 121	1 050 122	46 496 203	1 034 704	45 717 161

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada" (see Table 5 for list of establishments surveyed).

[1] Combined to avoid disclosing confidential company data.

TABLE 8. CANADA, SALES OF EXPANDED SLAG, PERCENTAGE BY END USE, 1997-99

Use	1997	1998	1999
		(%)	
Concrete block manufacture	74.5	72.6	90.0
Ready-mix concrete	3.3	5.3	10.0
Miscellaneous uses	22.2	22.1	–

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 9. CANADA, SALES OF EXPANDED CLAY AND SHALE, PERCENTAGE BY END USE, 1997-99

Use	1997	1998	1999
		(%)	
Concrete block manufacture	54.0	44.2	52.7
Loose insulation	41.6	52.2	43.4
Precast concrete manufacture	1.5	1.2	2.0
Ready-mix concrete	2.9	1.1	2.0
Horticulture and miscellaneous uses	–	1.2	–

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 10. CANADA, SALES OF EXPANDED PERLITE, PERCENTAGE BY END USE, 1997-99

Use	1997	1998	1999
		(%)	
Horticulture and agriculture	92.0	94.7	93.9
Loose insulation and miscellaneous uses	7.3	4.7	5.7
Insulation in gypsum products	0.8	0.6	0.4

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 11. CANADA, SALES OF EXPANDED VERMICULITE, PERCENTAGE BY END USE, 1997-99

Use	1997	1998	1999
		(%)	
Horticulture	86.1	83.6	78.9
Loose insulation	2.1	2.9	2.6
Miscellaneous uses	11.8	13.6	18.5

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

Nickel

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(Author notes: [1] This review concentrates on production facilities. The format of the production data has been changed to make it more readable and more comparable between operations. The extensive coverage of Canadian operations in 2000 precludes similar coverage for foreign operations of non-Canadian companies in 2000. [2] Only material relating to events in 2000 is covered in this review. [3] This chapter includes some information about cobalt as it relates to nickel; it does not provide a comprehensive review of cobalt.)

Abbreviations used in this review include:

Ag Silver; Au Gold; Co Cobalt; Fe Iron; FeNi Ferro-nickel; H_2SO_4 Sulphuric acid; HPAL High pressure acid leach; Ir Iridium; Ni Nickel; PAL Pressure acid leach; Pd Palladium; PGMs Platinum group metals; Pt Platinum; Rh Rhodium; Ru Ruthenium; Se Selenium; SO_2 Sulphur dioxide; Te Tellurium.

OVERVIEW

World nickel mine production increased by 11.8%. World production of refined and finished nickel increased by 5.7%. Nickel use (formerly called "consumption") increased by 4.2%.

Cobalt data are less well documented than nickel data. A principal source of world information is The Cobalt Development Institute (CDI) <http://thecdi.com>. The data from the CDI are shown in Table 9, which shows cobalt production in 2000. Figures 3 and 4 show mine production and metal production of cobalt, respectively, from data of the International Consultative Group on Nonferrous Metals Statistics, 2000.

WORLD NICKEL DATA

	1999	2000
	(000 t)	
Mine production	1 058	1 183
Finished production	1 024	1 082
Usage (consumption)	1 082	1 127

Source: International Nickel Study Group (INSG) data, rounded to nearest 1000 tonnes.
Note: Refer to Tables 4-6 at the end of this review for data from 1996 to 2000.

LME ASK PRICES

		3	15	27
	Cash	month		
	(US$/t)			
Average	8 641	8 453	7 354	6 614
Maximum	10 660	10 380	8 655	7 540
Minimum	7 030	6 730	6 260	5 765

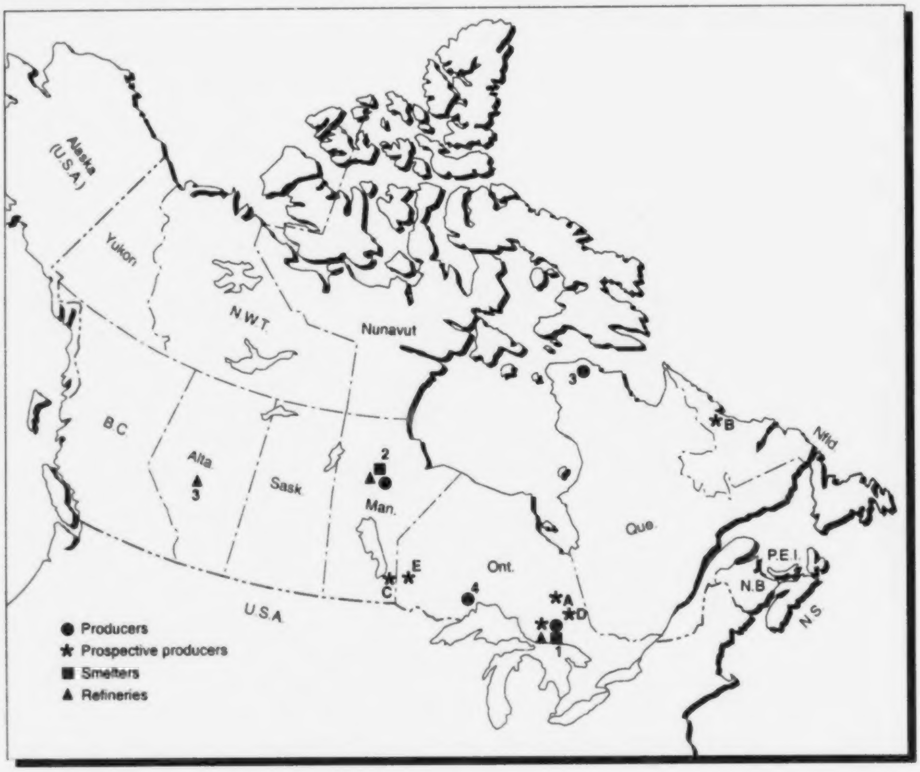
Sources: INSG; London Metal Exchange (LME).
Notes: Cash ask price = settlement price. Refer to Figure 2 for a graph of nickel prices in 2000 and for the period 1990-2000.

CANADIAN DATA

	1999	2000
	(t)	
Ni mine production[1]	186 236	190 727
Ni in concentrates shipped[2]	176 749	181 074
Ni refined production[3]	124 269	134 225
Ni usage[4]	22 527	24 932
Co mineral production[2]	2 014	2 013
Co metal production[3]	4 901	6 307
Co usage[4]	130	127

Ni = nickel; Co = cobalt.
[1] Metal in concentrates produced from Canadian mines. [2] Recoverable metal in concentrates shipped from Canadian mines. [3] Metal produced, whether from domestic or foreign origin. [4] Use includes metal in scrap and other recycled forms.

Figure 1
Nickel and Cobalt in Canada, 2000


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
3
4
A
B
C
D
E
● Producers
★ Prospective producers
■ Smelters
▲ Refineries

Numbers and letters refer to locations on map above

PRODUCERS

1. Falconbridge Limited (Fraser, Lindsley, Onaping-Craig, Lockerby)
1. Inco Limited (Coleman, Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Frood, Garson, Gertrude, McCreedy East, Stobie)
2. Inco Limited (Thompson, Birchtree)
3. Falconbridge Limited (Raglan)
4. North American Palladium Ltd. (Lac des Iles)

SMELTERS

1. Falconbridge Limited (Falconbridge)
1. Inco Limited (Copper Cliff)
2. Inco Limited (Thompson)

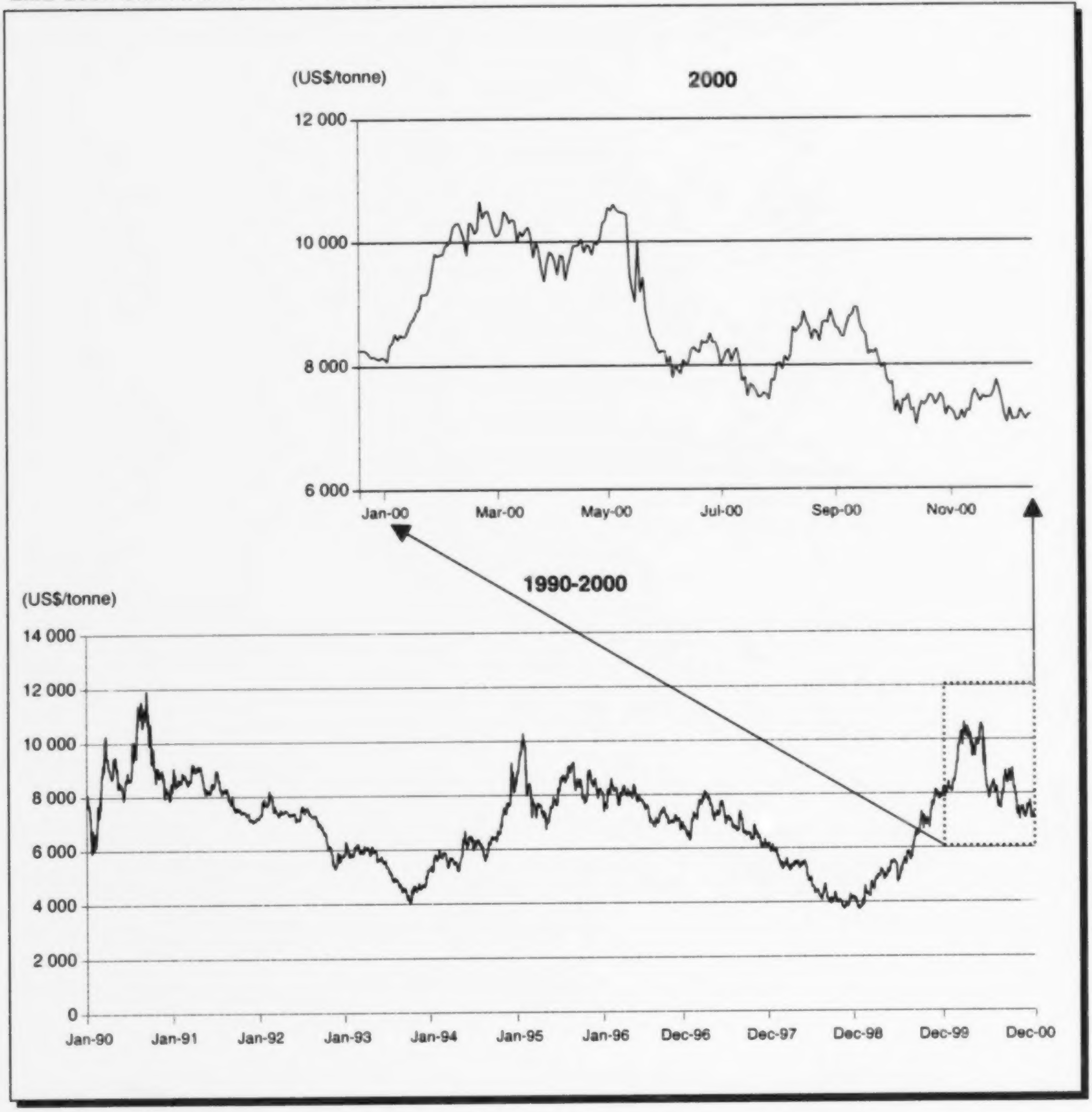
REFINERIES

1. Inco Limited (Sudbury)
2. Inco Limited (Thompson)
3. Sherritt International Corporation (Fort Saskatchewan)

PROSPECTIVE PRODUCERS

A. Outokumpu Mines Ltd. (Moncalm Township) (mine)
B. Inco Limited (Voisey's Bay mine)
C. Canmine Resources Corporation (Maskwa) (mine)
D. Canmine Resources Corporation (Cobalt, Ontario) (refinery)
E. Canmine Resources Corporation (Werner Lake) (mine)

Figure 2
LME Cash Settlement Nickel Prices, 1990-2000



Sources: International Nickel Study Group, Reuters; World Bureau of Metal Statistics.

The significant changes in Canadian nickel production in 1999 and 2000 were due to the lower mine production in Ontario resulting from a labour action at Falconbridge Limited's mines and smelter; these were offset by higher production at Falconbridge's Raglan mine in Quebec in 2000 and higher production at Inco Limited's Manitoba operation in 2000 (in 1999, a labour action in Manitoba's facilities reduced nickel output).

Canadian mine production of nickel (nickel contained in concentrates produced) was 181 027 t in 2000, up from 176 749 t in 1999. Primary nickel production in Canada was 134 225 t, up from 124 260 t in 1999 (Table 1).

Canadian exports and imports of various forms of nickel are shown in Table 1a; some data refer to contained nickel and other data refer to gross weights, according to the definitions of the *Harmonized Commodity Description and Coding System* (Harmonized System) for trade classification. Additional detail has been presented in Table 1a to clarify whether the tonnage is nickel content or the weight of material shipped. The most significant nickel exports from Canada are nickel oxide sinter exports to the United Kingdom,[1] nickel in matte exports to Norway, and unwrought nickel exports (of which over half went to the United States). The most significant nickel import was mixed nickel-cobalt feed for Sherritt International Corporation's refinery in Alberta. About 10 000 t of nickel intermediates were also imported.

Additional trade information is also presented in Table 1b, which shows the total trade of cupro-nickel, nickel-silver, stainless steel, and nickel-containing batteries. These data do not show the weight of the contained nickel but, rather, the entire weight of the material; thus, stainless steel data show the weight of nickel plus iron plus chromium plus other alloying elements.

Table 1c provides an historical summary of nickel production and use from 1970 to date for selected years.

Canadian shipments of recoverable cobalt in concentrate from Canadian mines totaled 2013 t in 2000, almost equal to the 2014 t produced in 1999. The lower output from Falconbridge's Sudbury mines was offset by increased production in 2000 relative to 1999 from the Raglan mine and from Inco's Thompson/Birchtree operations. Refined cobalt production was 4091 t in 2000, up from 3972 t in 1999. Table 2a shows the production and trade data for 1999 and 2000. Note that the unit of measurement for the data in Table 2a is kilograms.

Table 2b provides an historical summary of cobalt production and use from 1970 to date for selected years.

FALCONBRIDGE LIMITED

<http://www.falconbridge.com>

Falconbridge is the third largest producer of finished nickel in the world.

Its operations include: the Raglan mine/mill in Quebec, the Sudbury operations (four mines, a mill, a smelter and an acid plant) in Ontario, a refinery in Norway, and a mine and smelter in the Dominican Republic (see separate sections below).

Falconbridge's other projects include the Koniambo ferro-nickel (FeNi) smelter and mine project in New Caledonia, the Montcalm deposit and Bucko project in Canada, the Touba-Biankouma project in Ivory Coast, and the potential purchase of 25% of a nickel laterite project at Gag Island in Indonesia (see separate sections below).

Falconbridge is the world's largest cobalt recycler; it also toll refines cobalt material from other sources. A force majeure on cobalt shipments was declared in September and lifted in November (refer to the company web site for details).

Falconbridge produces and sells nickel in the following shapes: full plate cathode, cut cathode, SUPERELECTRO™ crowns, D crowns, microcrowns, D-microcrowns, and FeNi cone.

Securities documents are available on the Internet at <http://www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000376&lang=EN>.

Noranda Inc. <http://www.noranda.com> increased its ownership of Falconbridge to 50.1% in July and, by year-end, held 54.9% of common shares.

Sudbury Operations

Four underground mines operate in the Sudbury basin: the Craig, Fraser, Lindsley and Lockerby mines.

All mine ore is sent to the 10 000-t/d Strathcona mill for processing to concentrate; nickel-copper concentrate is sent to the company's smelter.

FALCONBRIDGE MINE PRODUCTION

Mine	2000
Craig	811 000 t @ 1.88% Ni, 0.69% Cu
Fraser	555 000 t @ 1.22% Ni, 2.45 % Cu
Lindsley	236 000 t @ 1.17% Ni, 1.11% Cu
Lockerby	189 000 t @ 1.75% Ni, 0.97% Cu
Total	1 791 000 t @ 1.57% Ni, 1.32% Cu

Smelter

- Has an electric furnace and Pierce Smith converters with a capacity of 70 000 t/y of nickel in about 130 000 t of nickel-copper matte; roaster gas is sent to the adjacent 300 000-t/y sulphuric acid plant.

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[1] Trade data for 1999 and 2000 show exports of nickel in matte to the United Kingdom but no nickel oxide sinter; an investigation began in 2001 about the classification of some of these exports in 2000 to the United Kingdom.

- Matte is exported to the company's Nikkelverk refinery in Norway.
- Concentrate is sourced from Falconbridge's own Sudbury mines and its Raglan mine, as well as from recycled materials.
- Has received permission from the Ontario government to export nickel-copper matte containing up to 45 360 t of recoverable nickel from mines in Ontario until the end of 2009.
- Recycles significant amounts of nickel and cobalt; in 2000, 2950 t of nickel were recovered from recyclable feed material (included in data totals below).

FALCONBRIDGE SMELTER PRODUCTION BY SOURCE

	1999	2000
	(t)	
Ni in matte from Sudbury mines	33 041	22 221
Ni in matte from Raglan mine	18 912	22 266
Ni in matte from custom feed	3 814	2 952
Total Ni in matte	55 767	47 439
Co in matte from Sudbury mines	732	556
Co in matte from Raglan mine	307	330
Co in matte from custom feed	1 375	906
Total Co in matte	2 414	1 792

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 20.2 Mt @ 1.49% Ni, 1.34% Cu.
- Measured + indicated resources = 16.3 Mt @ 2.47% Ni, 1.22% Cu.
- Inferred resources = 15.6 Mt @ 1.75% Ni, 2.04% Cu.

2000 Notes

- A strike by the Sudbury Mine, Mill & Smelter Workers' Union Local 598/C.A.W. <http://www.minemill598.com> began on August 1 and continued through the remainder of 2000; there was limited mine production by management after August 1.
- The smelter operated during the labour strike using concentrate from the Raglan mine plus concentrate from limited mine production from the Sudbury mines.
- Onaping Depth project:
  - reserves at depth of 2300-2600 m;
  - feasibility study delayed by strike;
  - completion of study is scheduled for mid-2001;
  - has indicated resources of 14.6 Mt @ 2.5% Ni, 1.15% Cu;
  - has an additional 1.2 Mt/y of inferred resources @ 3.61% Ni and 1.21% Cu.

Falconbridge's Canadian Properties

Montcalm Property

- Falconbridge signed a letter of intent with Outokumpu Mines Inc.; Falconbridge can earn a 50% interest in the Montcalm deposit near Timmins, Ontario.
- A decision on whether to finalize the agreement was expected in 2001; Falconbridge would fund an exploration and feasibility study.
- Deposit has an indicated + inferred resource of 7.75 Mt @ 1.48% Ni, 0.7% Cu.
- An operating rate of 6000 t/y of nickel in concentrate is being considered.
- Concentrate would be processed at Falconbridge's Sudbury smelter.

Bucko Project

- Nuinsco Resources Limited <http://www.nuinsco.ca> signed an option with Falconbridge to acquire 100% of the Bucko deposit and a 49% interest in the Strong Lake/Moak claims, subject to a number of conditions.
- $1.5 million was spent during 2000 on diamond drilling and equipment purchases, including surface buildings, pumps and a mine hoist.
- Shaft dewatering and bulk sampling are planned during 2001.
- A 5000 to 7000-t bulk sample is to be processed at Inco's Thompson facility.
- Approvals were received for site construction, underground development and a road/power line corridor.
- Calculated mineral inventory:
  - indicated = 1.5 Mt @ 2.36% Ni (diluted);
  - inferred = 0.5 Mt @ 1.99% Ni (diluted).
- Will use an existing Falconbridge shaft to 800-m depth.

New Quebec Raglan Mines Limited

<http://www.falconbridge.com>

Raglan Mine

- Located north of 60° N latitude, at Katinniq, Nunavik Territory, Quebec.
- New Quebec Raglan owns 100% of Société minière Raglan du Québec ltée, which in turn owns 100% of the Raglan operation.
- There is significant participation by local Aboriginal groups in the labour force and as contractors.
- The operation is 100% owned by Falconbridge Limited.

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 19.5 Mt @ 2.85% Ni, 0.78% Cu.
- Indicated + inferred resources = 5.7 Mt @ 2.19% Ni, 0.77% Cu.
- Ore also contains cobalt and platinum group metals.

RAGLAN MINE PRODUCTION

	1999	2000
	(t)	
Ni in concentrate	19 524	23 089
Co in concentrate	238	289

2000 Notes

- The Raglan mine was not affected by the strike in Sudbury.
- The mill production rate increased from 0.8 Mt/y to 1 Mt/y of ore in the second half of the year.
- A $12 million exploration program was conducted in 2000:
  - the operation is seeking additional ore reserves that would permit a production increase to 30 000 t/y of nickel;
  - 2001 exploration expenditures are targeted at $10 million;
  - 853 000 t of ore grading 2.45% Ni and 0.81% Cu in Lens D (located 15 km east of the concentrator) was added to the mineral inventory in 2000.
- A mill optimization plan is scheduled for completion in 2001; this should raise capacity to 3000 t/d from its current rate of 2400 t/d.

Falconbridge Nikkelverk Aktieselskap

<http://www.falconbridge.com>

Nikkelverk Refinery

- This chlorine leach/electrowinning refinery, located in Kristiansand in southern Norway, has a capacity of 85 000 t/y Ni, 40 000 t/y Cu and 4500 t/y Co; its acid plant capacity is 100 000 t/y of sulphuric acid.
- Can be expanded to 100 000 t/y Ni, 60 000 t/y Cu and 5000 t/y Co.
- Feed sources:
  - nickel-copper matte from Falconbridge's Sudbury smelter and the Bamangwato Concessions Limited's (BCL) smelter in Botswana accounted for the majority of feed to the refinery;
  - the refinery toll refines cobalt from WMC Limited's Australian operations;
  - Falconbridge has a contract to the end of 2010 with Centametall AG, which purchases matte from BCL, to process between 13 000 and 16 000 t/y of nickel in matte.
- The operation is owned 100% by Falconbridge Limited.

NIKKELVERK PRODUCTION

	1999	2000
	(t)	
Ni	74 137	58 679
Co	4 041	3 431

2000 Notes

- The refinery had a five-day work stoppage in November in support of the labour action at Falconbridge's Sudbury operations.
- Feed to the refinery was reduced due to the strike at Sudbury.
- Custom feed amounted to 28% of nickel output and 75% of cobalt output at the refinery.
- Refinery recovered 6.8 t of PGMs, up about 10% from 1999.

Falconbridge Dominicana, C. por A. (Falcondo) <http://www.falconbridge.com>

Falcondo

- The nickel laterite mine and FeNi smelter are located at Bonao, Dominican Republic; the mine/smelter has a capacity of about 30 000-32 000 t/y Ni in FeNi.
- Mining is by loaders and trucks; the FeNi plant is powered by a 200-MW, oil-fired power plant; production costs are highly dependent upon the oil price.
- The mine is owned by: Falconbridge, 85.26%; the Dominican Republic, about 10%; and Redstone Resources Inc., a subsidiary of Franco-Nevada Mining Corporation <http://www.franco-nevada.com>, about 4.1%.

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 65.1 Mt @ 1.16% Ni.
- Indicated resources = 13.8 Mt @ 1.53% Ni.
- Inferred resource = 6.4 Mt @ 1.44% Ni.
- Stockpiled material added to probable reserves in 2000 is to be fed to the plant starting in 2002.

FALCONDO PRODUCTION

	1999	2000
	(t)	
Ni in FeNi production	24 500	27 800

2000 Notes

- Higher fuel costs had an impact on the economics of the operation; power plant and electric furnace problems reduced production by 1000 t from target.
- A labour contract was concluded in January, running until December 1, 2002.

Koniambo Project

<http://www.falconbridge.com>

Falconbridge can earn 49% of a joint venture with La Société Minière du Sud Pacifique S.A. (SMSP) and Société de Financement et d'Investissement de la Province Nord (SOFINOR), SMSP's controlling shareholder.

A laterite nickel mine and a FeNi smelter to produce 60 000 t/y Ni in FeNi, as well as a power plant and port, are being studied; a US$85 million bankable feasibility study that started in the fourth quarter of 1998 is scheduled for completion in the fourth quarter of 2002.

Mineral inventory

- Inferred resource = 151 Mt @ 2.58% Ni, 0.07% Co.

2000 Notes

- Diamond drilling, an environmental baseline study and scoping studies were completed.
- US$21 million was spent in 2000.
- Requests for proposals to build a 300-MW power plant were sent out to qualified bidders.
- US$40 million is budgeted for expenditure in 2001/02.

Gag Island Project - PT Gag Nickel

- Gas Island hosts a nickel-cobalt laterite deposit; Gag Island is located 150 km west of Irian Java in Indonesia.

- A 1997 prefeasibility study considered 40 000 t/y of nickel output.

- Ownership of PT Gag Nickel: BHP Limited, through BHP Asia Pacific Nickel Pty Ltd, 75%; PT Aneka Tambang (Persero) Tbk, 25%.

Mineral Inventory to Mid-2000

- Measured + indicated resources = 105 Mt @ 1.45% Ni, 0.07% Co.
- Inferred resource = 135 Mt @ 1.33% Ni, 0.09% Co.

2000 Notes

- A tentative agreement was reached in 2000 between Falconbridge and BHP Limited whereby Falconbridge could earn half of BHP's interest in PT Gag Nickel.
- Subject to final agreement, Falconbridge could fund a feasibility study costing US$75 million to earn 37.5% of ownership by mid-2002.
- Regulatory issues to be resolved with the Indonesian Department of Forestry involve seeking recognition of PT Gag Nickel's prior right to use surface mining techniques in an area later decreed to be a protected forest.
- Agreement had not been finalized as of year-end.

La Société pour le Développement Minier de la Côte d'Ivoire

<http://www.falconbridge.com>

The Touba-Biankouma nickel-cobalt laterite resource, located in Ivory Coast 500 km inland, consists of four significant deposits: Sipilou North, Foungouesso, Moyango and Viala.

Other ore deposits include Sipilou South, Yamatoulo and Touoba.

Development of infrastructure, including a railway to the coast and a developed energy supply, is needed to permit profitable development of the mine/hydrometallurgical processing facilities.

The project is owned by Falconbridge and the Ivory Coast government.

Mineral Inventory to Year-End 2000

- Indicated resource = 126 Mt @ 1.57% Ni, 0.11% Co.
- Inferred resource = 138 Mt @ 1.39% Ni, 0.12 % Co.

2000 Notes

- Test work on laterite ore processing options continued.
- In October, Consolidated Trillion Resources Ltd. sold its 15% interest in the Touba-Biankouma nickel-cobalt laterite deposit in Ivory Coast to Falconbridge International (Investments) Limited for US$2.5 million.

INCO LIMITED

<http://www.inco.com>

Inco is the largest nickel producer in Canada (second largest in the world), producing nickel in various forms, including specialty products (e.g., powders and foams); by-products include Cu, Co, Au, Ag, PGMs, Se, Te, H_2SO_4 and liquid SO_2.

Inco's mines, smelters and refineries, associated plants, and projects in Ontario and Manitoba consist of:

- 12 mines;
- two concentrators;

- a nickel-copper smelting complex (including dryers and Pierce Smith converters) and a nickel smelter;
- two nickel refineries;
- one nickel oxide sinter plant;
- a copper refinery;
- a precious metals refinery;
- a cobalt refinery;
- an H_2SO_4 plant and a liquid SO_2 plant; and
- the Voisey's Bay project in Newfoundland and Labrador.

Inco has overseas facilities that it operates and owns varying percentages of:

- The International Metals Reclamation Company, Inc.'s (INMETCO) nickel-cadmium recycling plant in the United States, 100%;
- a nickel refinery in Wales, United Kingdom, 100%;
- a laterite nickel mining/smelting operation in Indonesia called PT International Nickel Indonesia Tbk (PT Inco), 59%; and
- a PGMs refinery at Acton, in London, United Kingdom, 100%.

Inco has a number of operations and a project in which it has varying degrees of ownership, including:

- a nickel refinery, Inco TNC Limited, in Japan, 67%;
- a nickel refinery, Korea Nickel Corporation (KNC), in South Korea, 25%;
- a nickel refinery, Taiwan Nickel Refining Corporation (TNRC), in Taiwan, China, 49.9%;
- a nickel salts plant, Jinco Nonferrous Metals Co., Ltd, in China, 65%; and
- a nickel laterite mine/hydrometallurgical project, Goro Nickel S.A., in New Caledonia, 85%.

Inco's nickel products include: cathode, high-purity pellets and powder, UTILITY™ nickel (about 97% Ni), nickel oxide sinter 75™ (75% Ni), various specialty products (e.g., INCOFOAM™, nickel disks), electrolytic cobalt (99.9% Co), and black cobalt oxide (about 71.5% Co as Co_3O_4).

Securities information is available on the Internet at <http://www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN>.

Inco is owned 45% by Canadian residents, 54% by U.S. residents and 1% by others.

Nickel and By-Product Production in 2000

Cobalt sales, not production, is reported. The Cobalt Development Institute (CDI) shows production information reported to it, indicating total Inco cobalt production as 1470 t in 2000 and 1420 t in 1999; 80% of Inco's cobalt production is sold as metal while the balance is sold as cobalt oxide.

Inco's PGMs production, principally from its mines in Sudbury, plus purchased material derived from spent automotive catalysts and other materials, totaled 10.7 t in 2000.

Inco also produced 114 397 t of copper in 2000. Gold deliveries were 2 t, silver deliveries were 42.4 t, and H_2SO_4 (sulphuric acid) plus liquid SO_2 deliveries totaled 578 000 t.

See tables below for nickel production.

INCO CORPORATE PRODUCTION

Region[1]	1999	2000	2001[f]
		(t)	
Ni from Ontario Division[2,3]	99 800	98 000	97 500
Ni from Manitoba Division[3]	33 600	45 800	47 600
Ni from Indonesia (counting all PT Inco output)	43 500	59 000	63 500
Total counting all PT Inco output	176 900	202 700	208 600

[f] Forecast released in third quarter of 2001.
[1] Data may not add due to rounding to nearest 100 t. [2] Ontario Division includes nickel refinery in Clydach, Wales, where Inco operates a carbonyl nickel refinery, the U.K.'s only nickel refinery; U.K. refined nickel production was 38 100 t in 1999 and 38 000 t in 2000. [3] Data include material purchased and tolled from other locations, including concentrate from Australia and an undetermined amount of recycled nickel. [4] PT International Nickel Tbk's total production is shown by Inco as its total production; if only 59% of PT's output is assigned to Inco (Inco owns 59% of the equity), then the above table would become as restated in the table below.

INCO CORPORATE PRODUCTION RESTATED

Region[1]	1999	2000	2001[f]
		(t)	
Ni from Ontario[2,3]	99 800	98 000	97 500
Ni from Manitoba[3]	33 600	45 800	47 600
Ni from Indonesia (counting 59% of PT Inco output)	25 700	34 800	37 500
Total counting 59% of PT Inco output	159 000	178 600	182 600

(Refer to the previous table for explanation of footnotes.)

2000 Corporate Notes

The buy-back of 26 million Class VBN shares was completed at a cost of $7.50 per share plus 0.45 of an Inco Common Share purchase warrant with an exercise price of US$30 per share.

Contracts were negotiated to import nickel concentrates from Australia for the Thompson/Sudbury smelters; the contracts are expected to supply 80 000 t of nickel in concentrates between 2000 and 2005 from the Cosmos mine and future Emily Ann mine in Australia.

The 1997 objective to cut costs by US$250 million per year was met in 2000.

Negotiations with the Government of Newfoundland and Labrador about the Voisey's Bay project were halted in January and did not restart in 2000 (see Voisey's Bay below).

Sudbury, Ontario Operations

Inco has permission from the Province of Ontario to export the following intermediate products from ores mined in Ontario until year-end 2005:

- nickel oxide sinter and nickel sulphate residue to Inco's Clydach, Wales, in the United Kingdom; and
- semi-refined PGMs concentrate to Inco's PGMs refinery in Acton, U.K.

Production in 2000 was 98 000 t of finished nickel (this includes production refined at the Clydach refinery in the U.K.).

Mines operating at the end of 2000 (all underground except Gertrude) were Coleman, Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Frood, Garson, Gertrude, McCreedy East, and Stobie. (The Coleman, Crean Hill and Frood mines will close in 2001.)

Mill

- The Clarabelle mill is located between Inco's Copper Cliff North mine and the Copper Cliff smelter.
- Processes employed are crushing, grinding, flotation and magnetic separation.
- Mill capacity is 36 000 t/y.
- The mill head grade in 2000 was 1.57% Ni and 1.67% Cu, compared to 1.41% Ni and 1.40% Cu in 1999.

Smelting and Refining

- Nickel smelter smelts bulk Ni-Cu concentrate; after subsequent separation by slow cooling and milling, Ni is sent to matte plant and refinery; capacity is 100 000 t/y Ni, subject to SO_2 emission limits.
- Matte processing plant produces nickel oxide sinter; capacity is 18 000 t/y.
- Nickel refinery uses the carbonyl process to produce high-purity nickel; capacity is 59 000 t/y.
- SO_2 emissions in 2000 were 13% below the provincial regulatory limit.

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 225 Mt @ 1.30% Ni, 1.23% Cu.
- Ore grade mined in 2000 = 1.57% Ni, 1.67% Cu (1.41% Ni, 1.4% Cu in 1999).
- Inco's Sudbury by-product metals account for 70% of the company's cobalt production, 92% of its precious metal production, and 92% of it copper production. Only nickel is recovered from PT Inco in Indonesia.

2000 Notes

- A labour agreement in Sudbury and Port Colborne was signed in May; it runs from June 2000 to May 2003.
- Creighton Deep project: Ongoing work on US$125 million development project at Creighton mine to produce 10 900 t/y Ni, 9500 t/y Cu and 0.88 t/y PGMs beginning in 2002:
  - Phase 1: 2.8 Mt proven ore @ 3.34% Ni, 2.8% Cu to start in 2001; reserves to 2013;
  - Phase 2: 3.4 Mt probable ore @ 3.77% Ni 3.5% Cu; to produce over the 2005-19 period.
- Stobie mine: Decision was made to develop the low-grade section of the mine, raising total mine production to over 20 000 t/y Ni for the period 2001-16.
- McCreedy East mine: US$33 million mine expansion announced in July:
  - 7.6 Mt @ 1.88% Ni, 0.84% Cu, 0.91 g/t PGMs to be developed;
  - full production expected by late 2004 will raise output of McCreedy East mine from 13 150 t/y to 21 800 t/y Ni;
  - exploration continued on high-grade PGMs deposit and will extend into 2001.
- Totten discovery:
  - exploration continued on 7.6 Mt @ 1.28% Ni, 1.73% Cu, 4.3 g/t PGMs probable ore discovered in 1999;
  - ore accessible from Totten shaft (maintained on standby basis);
  - environmental permitting to commence in 2001;
  - initial production targeted by 2005.
- Copper Cliff North mine:
  - in addition to Ni and Cu production, a high-grade PGMs orebody went into production in the fourth quarter producing from reserves of 0.3 Mt @ 0.9% Ni, 4.5% Cu, 16.4 g/t PGMs;
  - more drilling of the PGMs orebody is planned in 2001.

- Pump Lake deposit:
  - exploration continued on precious-metal-rich zone located 2.5 km north of Copper Cliff South shaft; more exploration planned in 2001.
- Kelly Lake deposit:
  - exploration continued of 5.9 Mt of probable ore @ 2.07% Ni, 1.38% Cu, 4.2 g/t PGMs plus Au;
  - ore discovered in 1997, located 2 km south of Copper Cliff South shaft;
  - announcement in March that development decision is expected in 2000, but no decision was announced in 2000.
- Victor Deep project: additional engineering studies were completed; further exploration from surface was undertaken in 2000 and is to continue in 2001.
- Clarabelle mill:
  - handles all mine ore production from Inco's Sudbury operations;
  - increased recovery by 2.5% during 1999-2000 with plans to increase by a further 2% in 2001.
- Ongoing work to develop additional means to reduce SO_2 emissions from Sudbury operations.

Thompson, Manitoba Operations

Production in 2000 was 46 000 t finished Ni. Underground mines operating at the end of 2000 were Thompson and Birchtree.

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 42 Mt @ 2.26% Ni, 0.14% Cu.
- Ore grade mined in 2000 = 2.38% Ni (2.47% Ni in 1999).

Mill

- Thompson mill is located on the same site as the Thompson mine.
- Processes employed are crushing, grinding and flotation.
- Mill capacity is 16 000 t/d.
- The mill head grade in 2000 was 2.38% Ni (no Cu grade disclosed) compared to 2.47% in 1999.

Smelting and Refining

- Nickel smelter smelts partially roasted nickel concentrate in electric furnaces for feed to electrolytic refinery; copper concentrate from Manitoba ores is sent to the company's Sudbury smelter for processing.
- Nickel refinery produces both cathode and plating-grade nickel rounds[1] by electrolytic process; total capacity is 55 000 t/y.
- SO_2 emissions limit nickel output; emissions were 2% below the provincial regulatory limit in 2000.

2000 Notes

- Full production resumed in January (the Thompson operations restarted in December 1999 when a labour contract was signed after a strike in 1999).
- US$48 million Birchtree mine deepening project was announced in January to develop 13.6 Mt @ 1.79% Ni:
  - project is sufficient to extend the mine life for at least 15 years, permitting mine production to increase to 3175 t/d of ore from the existing 1635 t/d;
  - project completion target is 2002.
- Exploration work in the Thompson area included drilling and geophysical work; further drilling is planned in 2001.
- Phasing out of copper smelting at Thompson was completed.
- Imported and processed 1300 t of nickel in concentrate from Jubilee Mines NL's Cosmos pit during 2000; Jubilee shipped further additional material from Australia in October and December.
- Various nickel properties/exploration projects in Manitoba could provide the Thompson smelter with opportunities for future concentrate feed, including the Mel project and the Minago deposit.
  - Mel project:
    - Inco agreement with Nuinsco Resources Limited <http://www.nuinsco.ca> in 1999 in which Nuinsco has option to acquire up to 100% of the Mel property, subject to a number of conditions;
    - deposit discovered by Inco in 1961; indicated resource of 0.29 Mt @ 1.69% Ni plus 0.26 Mt @ 1.69% Ni, based upon 1.25% Ni cut-off, to depth of 230 m;
    - Nuinsco's target is to outline at least a 0.8-Mt resource grading at least 1.6% Ni accessible by ramp, to a depth of 250 m, with milling to be done at the Thompson mill, 40 km away;
    - drilling started in early 2000; more work is scheduled in 2001.
  - Minago deposit:
    - purchased by Nuinsco in 1999 from Black Hawk Mining Inc. <www.bhmining.com>;
    - probable reserves of 5.4 Mt @ 1.17% Ni plus possible resource of 5.2 Mt @ 1.21% Ni; Pd and Pt are also present.

Port Colborne Refinery

<http://www.inco.com>

- Produces cobalt by electrolytic refining.
- Recovery of nickel from material in process.
- Precious metals upgrading.
- Cobalt production data not released; The Cobalt Development Institute reports Inco total cobalt production at 1470 t.

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[1] "S" rounds and "R" rounds.

Clydach Refinery

<http://www.inco.com>

- Carbonyl nickel refinery located near Swansea, United Kingdom.
- Production capacity of 40 000 t/y high-purity nickel as pellets, powder and specialty products such as INCOFOAM™.
- Refinery takes nickel oxide sinter, nickel sulphate matte, and nickel sulphate residue from Sudbury, with permission of the Ontario government for export, for feed to the carbonyl process.
- Nickel oxide residues are returned to Sudbury for subsequent processing to remove by-product metals.
- Ownership: Inco Limited, 100% (plant output considered to be part of the "Ontario Division" production).

CLYDACH PRODUCTION

	1999	2000
	(t)	
Ni	38 100	38 000
Co	n.a.	n.a.

Source: INSG data for U.K. production of refined nickel.
n.a. Not applicable.

2000 Notes

- First INCOFOAM™ line reached full production rate.
- Second INCOFOAM™ line was commissioned to produce nickel foam material for batteries in vehicles using electric drive and in cordless consumer products.

PT International Nickel Indonesia Tbk (PT Inco) <http://www.inco.com>

- Nickel laterite mine and four electric furnaces located in Sorowako, Sulawesi, Indonesia.
- Produces nickel in matte grading 77-80% Ni; capacity is 68 000 t/y Ni in matte.
- Owns 165-MW and 93-MW hydro-electric generating facilities to produce low cost of power, but still requires 2.6 million barrels per year of oil.
- Matte production is exported to Japan: 80% to Inco TNC and 20% to Sumitomo.
- The company ownership is: 59%, Inco Limited; 20%, Sumitomo Metal Mining Co., Ltd.; and 20%, public holdings.

PT INCO PRODUCTION

	1999	2000
	(t)	
Ni in matte	45 000	59 200

Mineral Inventory to Year-End 2000

- Proven reserves = 91 Mt @ 1.82% Ni.
- Probable reserves = 10 Mt @ 1.79% Ni.
- Indicated + inferred resources = 301 Mt @ 1.81% Ni.

2000 Notes

- Ongoing ramp-up of US$633 million expansion (completed in 1999) from 45 000 t/y to 68 000 t/y Ni in matte; design capacity is expected to be reached by year-end 2001.
- A two-year labour agreement, negotiated in December, extends to November 2002.

Inco TNC Limited

<http://www.inco.com>

- Nickel refinery located at Matsauzka, Japan.
- Capacity expansion to 60 000 t/y from 40 000 t/y was completed in 1998.
- Imports nickel matte from PT Inco in Indonesia to produce nickel oxide sinter (75% Ni) plus a low-grade refined nickel brand (Tonimet, about 96% Ni).
- The company ownership is: Inco Limited, 67%, and Sumitomo Metal Mining Co., Ltd., about 13%.

INCO TNC PRODUCTION

	1999	2000
	(t)	
Contained Ni	30 000	48 000

Jinco Nonferrous Metals Co., Ltd.

<http://www.inco.com>
<http://www.jnmc.com/cn/engjnmc/>

- Produces nickel salts for plating (nickel chloride and nickel sulphate).
- Located near Shanghai.
- Ownership: Inco Limited, 65%, and Jinchuan Nonferrous Metals Corporation, 35%.
- Nickel sulphate production increased in 2000 (no production data were released).

Korea Nickel Corporation (KNC)

- 32 000-t/y refinery located in Onsan, South Korea.
- Imports nickel oxide sinter to make UTILITY™ nickel (97% Ni content).
- New refinery was officially inaugurated in August 1999; old 16 500-t/y plant was placed on standby.
- Ownership: Inco Limited, 25%, and Korea Zinc Co., 19%.

KNC PRODUCTION[1]

	1999	2000
	(t)	
Contained Ni	19 000	29 000

[1] This production is considered to be reprocessing, not primary, production as KNC takes a finished product (nickel oxide sinter grading about 75% Ni, which can be used directly by the stainless steel industry) and transforms it into another finished product as noted above.

2000 Notes

- Production was limited by a lack of feed during 2000.
- Imports of nickel oxide sinter during 2000 were 37 700 t (gross weight, containing about 29 000 t Ni, assuming material graded 77% Ni), sourced principally from Japan.

Taiwan Nickel Refining Corporation

- Refinery was completed in 1983 by a partnership of Inco Limited and Talent Metal Company at Kaohsiung Hsien, Taiwan; it is the only nickel refinery in Taiwan, China.
- Imports nickel oxide sinter to make UTILITY™ nickel (97% Ni content).
- Capacity: 14 000 t/y (1993).
- Taiwanese imports of nickel oxide sinter were 10 767 t in 1999 and 11 586 t in 2000.
- Assuming that all these imports were refined at Taiwan Nickel, that the nickel oxide sinter averaged 77% Ni content, and that the nickel recovery rate in the plant was above 99%, then the implied throughput of the plant averaged in the order of 8300-8600 t/y over the period 1999-2000.
- Ownership: joint venture with Inco Limited owning a 49.9% interest.
- This production is considered to be reprocessing, not primary, production because Taiwan Nickel takes a finished product (nickel oxide sinter grading about 75% Ni, which can be used directly by the stainless steel industry) and transforms it into another finished product, as noted above.

Voisey's Bay Project, Newfoundland and Labrador <http://www.inco.com>

- Large sulphide nickel-copper-cobalt deposit located in Newfoundland and Labrador, close to the Atlantic Ocean near the town of Nain.
- The federal and provincial government responses to the Environmental Assessment Panel report released in mid-1999 allow Voisey's Bay Nickel Company Limited to apply for the licences required for the project to proceed.
- The federal government response of 1999 was challenged by the Labrador Inuit Association and Innu Nation in 1999. The challenge was subsequently stayed a number of times until mid-2001.
- Separate negotiations by Inco with the Labrador Inuit Association and Innu Nation were halted after the Inco-province impass over further processing in the province (see below).
- Ownership: 100% Inco Limited through its subsidiary, Voisey's Bay Nickel Company Limited.

Mineral Inventory to Year-End 2000

- Ovoid, Eastern Deeps, Western Extension and other smaller zones contain:
  - proven open-pit reserves at the Ovoid Zone = 32 Mt @ 2.83% Ni, 1.68% Cu, 0,14% Co;
  - indicated open-pit resources = 10 Mt @ 0.92% Ni, 0.72% Cu;
  - indicated + inferred underground resources = 99 Mt @ 1.27% Ni, 0.59% Cu.

2000 Notes

- Negotiations with the Government of Newfoundland and Labrador broke off in early January over processing conditions, namely, the provincial government wanted a guarantee that processing would take place in the province whereas Inco wanted the ability to send nickel concentrate to existing facilities in Ontario and Manitoba for some period of time.
- In early January, Inco announced that it had been considering a project consisting of:
  - a US$500 million, 6000-t/d mine/mill;
  - a US$95 million underground exploration project, including shaft sinking; and
  - a US$125 million research and development program, including a pilot plant for a hydrometallurgical process to treat nickel sulphide concentrates.
- Share redemption was approved by shareholders in November giving Inco 100% ownership in Class VBN shares.
- NM Rothchild & Sons' valuation of Class VBN shares included Rothchild's two scenarios for possible development at Voisey's Bay:
  - Scenario one: 25-year life, 50 000-t/y project with 50 000-t/y hydrometallurgical plant; and
  - Scenario two: 25-year life, 81 500-t/y project with 50 000-t/y hydrometallurgical plant.
- Further details can be found in Schedule A of Inco's prospectus dated September 15, 2001, available on the Internet at <http://www.sedar.com/csfsprod%2Fdata21%2Ffilings%2F00298207%2F00000001%2FC%3A%5CMyFiles%5CInco%5CBanjo%5Ccircular.pdf>.
- Process R&D work for hydrometallurgical recovery of Voisey's Bay nickel-cobalt concentrate continued; integrated mini-pilot plant testing was expected to commence in 2001.
- Cost of exploration activities in 2002 was US$6 million for:
  - 9600 m of Eastern Deeps definition drilling;
  - grass-roots exploration targets tested at Ryan's Pond, Red Dog and Sarah targets;
  - drilling at Ryan's Pond;
  - geophysical work and limited drilling at Nain Bay South; and
  - 16 000 m of drilling planned in 2001 for further definition drilling at Eastern Deeps and continued drilling at Ryan's Pond.

Goro Nickel S.A. Project

<http://www.inco.com>

- Inco Limited's subsidiary, Inco S.A., owns 85% of Société Minière de Xéré with Bureau de Recherches Géologiques et Minières de France (BRGM) owning the remaining 15%.

- Société Minière de Xéré owns 100% of Goro Nickel S.A., the company that will operate the Goro project.

- A US$50 million pilot plant operating since late 1999 is testing a proprietary pressure acid leach/solvent extraction process (PAL-SX).

- The plant is designed to operate at high temperatures and high pressures to allow increased throughput relative to lower-pressure PAL plants.

- A US$1.3 billion-$1.4 billion mine and hydrometallurgical plant are planned with a capacity of 54 000 t/y Ni in nickel oxide and 5400 t/y Co in the form of intermediates or metal.

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 47 Mt @ 1.59% Ni, 0.17% Co.
- Measured + indicated + inferred resources = 219 Mt @ 1.57% Ni, 0.18% Co.

2000 Notes

- The hydrometallurgical pilot plant continued operations through 2000.
- Detailed design for a bankable feasibility study is under way; negotiations with the government about the tax regime continued, as did the search for potential partners and financing.
- There was an announcement in December of a further US$100 million commitment to continue work in 2001 to prepare for the construction phase.
- Work planned for 2001 includes:
  - completing the bankable feasibility study in the first quarter of 2001;
  - finishing basic engineering;
  - obtaining environmental permitting;
  - finalizing the tax regime;
  - negotiating financing;
  - bringing a partner into the project; and
  - a final project decision is expected by mid-2001.

SHERRITT INTERNATIONAL CORPORATION <http://www.sherritt.com>

Sherritt International Corporation owns a 50% stake in Metals Entreprise, which in turn owns a laterite nickel-cobalt operation in Cuba and a hydrometallurgical nickel-cobalt plant at Fort Saskatchewan, Alberta. The other owner of Metals Enterprise is Compañia General de Niquel S.A. (GNC).

Metals Entreprise runs its operations in Cuba through Moa Nickel S.A., which operates the mine and the acid leach plant; the facility produces a high-grade nickel-cobalt sulphide material that is exported to Canada. Metals Enterprise owns The Cobalt Refinery Company Inc. (CRC), which operates the hydrometallurgical refinery in Canada. The feed from Cuba enters Canada classified under the Harmonized System classification of HS 2620.90, which records only gross tonnage and gross value.

Securities information is available on the Internet at <http://www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002460&lang=EN>.

Ownership: The Chairman of the Board of Sherritt International Corporation holds all of the multiple voting shares, giving him sufficient votes to elect a majority of the directors to the Board, subject to the limitations contained in its articles of incorporation. These limitations include provisions that the multiple voting shares are non-transferable, are not entitled to any dividends or distributions of assets, and are automatically converted into restricted voting shares on a share-per-share basis upon the occurrence of certain events.

2000 Corporate Notes

Sherritt increased its holdings in Anaconda Nickel Limited from 8.9% to 9.4%.

Sherritt purchased $75 million of its convertible debentures during the year; Deutsche Bank Canada contested the purchases in court and the case was unresolved at year-end.

Metals Enterprise

Metals Entreprise was formed in November 1995; it is a joint venture of Sherritt International Corporation and Compañia General de Niquel S.A. (GNC), which owns:

- Moa Nickel S.A., which operates a laterite nickel-cobalt laterite open-pit/pressure acid leach facility in Cuba yielding a high-grade nickel-cobalt sulphide;
- The Cobalt Refinery Company Inc. (CRC), which operates a nickel-cobalt refinery at Fort Saskatchewan, Alberta, that uses the nickel-cobalt material from Moa as its principal feed source (imported as HS2620.90, reported as gross tonnage); and
- International Cobalt Company Inc. (ICCI), which sources feed and markets nickel and cobalt output.

Sales arrangements for Metals Enterprise are:

- ICCI sells cobalt briquettes and powder through Sherritt International; and
- ICCI sells nickel powder and briquettes through its exclusive sales agent, Empresa Cubana Exportadora de Minerales y Metales (Cubaniquel).

Moa Nickel S.A. - Pedro Soto Alba Mine/Leach Plant <http://www.sherritt.com>

- A nickel-cobalt laterite mine plus pressure acid leach plant, located in Holguin Province, Cuba, about 5 km from the town of Moa.
- Mined ore is dissolved in sulphuric acid, then precipitated by H_2S gas under pressure to form a mixed nickel-cobalt sulphide material.
- Two orebodies are mined, Moa Occidental and Moa Oriental, with a cut-off grade of about 1% Ni.
- A mining concession was awarded to Moa Nickel S.A. in 1994 by the Cuban government.
- In the mid-1990s, consideration had been given to increasing the mine and leach plant throughput to produce 40 000 t/y of nickel plus cobalt in mixed sulphides.
- Ownership: Metals Enterprise, 100% (which in turn is owned 50% by Sherritt International Corporation and 50% by Compañia General de Niquel S.A.).

MOA BAY PRODUCTION

	1999	2000
	(t)	
Ni + Co in mixed sulphide output	27 020	29 520

Mineral Inventory

- Proven ore = 35.5 Mt @ 1.25% Ni, 0.14% Co.
- Probable ore = 2.4 Mt @ 1.16% Ni, 0.13% Co.
- An ore reserve re-evaluation in 2000 resulted in a downward revision by 6.1 Mt (which has been incorporated into the data above).

2000 Notes

- Mining began in the higher-grade Moa Oriental deposit in the fourth quarter of 2000; Moa Occidental had previously been the only source of ore.
- A new record was established for the production of nickel and cobalt in mixed sulphides due to higher-grade ore feed and debottlenecking, including a new thickener.
- Moa's production rate at the end of the last quarter of 2000 was equivalent to an annualized rate of 31 000 t/y of nickel plus cobalt in mixed sulphides.

The Cobalt Refinery Company Inc.

<http://www.sherritt.com>

- An ammonia leach, hydrogen reduction refining process with associated fertilizer production (original "Sherritt leach process"), located at Fort Saskatchewan, Alberta.
- Produces nickel powder and nickel briquettes, and cobalt powder and cobalt briquettes.
- Plant capacity = 30 000 t/y Ni, 3000 t/y Co, plus 165 000 t/y of ammonium sulphate fertilizer.
- Plant obtains feed from Moa Bay as mixed nickel-cobalt sulphides sent by ship to Nova Scotia, which is then railed to the refinery; feed from other sources is also obtained.
- Yearly output has increased progressively through debottlenecking.
- Ownership: Metals Enterprise, 100% (which in turn is owned 50% by Sherritt International Corporation and 50% by Compañia General de Niquel S.A.).

COBALT REFINERY COMPANY PRODUCTION

	1999	2000
	(t)	
Ni metal	28 643	28 070
Co metal	2 770	2 855

Note: Sherritt and GNC each get 50% of the above tonnages.

2000 Notes

- Record cobalt production.
- Plant debottlenecking continued, raising capacity by 1000 t/y.
- Production in 2001 is likely to increase as Metals Enterprise's Moa Bay mine is expected to increase production to 31 000 t of nickel plus cobalt in mixed sulphides.

CANMINE RESOURCES CORPORATION <http://www.canmine.com>

Canmine owns a refinery and three mining projects. The refinery and Werner Lake cobalt mine project are in Ontario. The Maskwa mine project and the BINCO nickel exploration project are in Manitoba.

Canmine is modernizing and expanding its hydrometallurgical cobalt-nickel refinery to process future feed from existing stockpiled material and from future Canmine mining in Canada. Canmine will also be able to process custom feed materials at the refinery once refurbishment is completed.

Securities filings are available on the Internet at <http://www.sedar.com/command_ servlet?cmd=DisplayCompanyDocuments&issuerNo=00012293&lang=EN>.

Canmine Refinery

- The hydrometallurgical cobalt-nickel refinery at Cobalt, Ontario, was purchased in late 1999 after the bankruptcy of Cobatec Inc.; the recovery of other metals such as copper, silver, gold or PGMs is possible.
- A $5.3 million refurbishment project is under way by AGRA Simons Ltd. to produce cobalt and nickel chemicals; initial capacity of 300 t/y of Co in chemicals; no production took place in 2000.
- Cobalt carbonate output supply contract with Sheppard Chemical Company of the United States is in place.
- Future feed sources: cobalt feed from the Werner Lake mine project (see below) and nickel-cobalt feed from the Maskwa mine project (see below).
- Subsequent refinery expansions to 1000 t/y Co and then to 2000 t/y Co are envisaged.
- Nickel recovery is to commence when refinery feed is sourced from the future Maskwa mine project (see below) or from purchased material.

2000 Notes

- Purchase of 13 100 t of stockpiled material from Agnico-Eagle Mines Limited, located 45 km from the refinery.
- Stockpile grade = 1.76-3.12% Co, 1275 g/t Ag (an estimated 225-400 t Co and 6.7 t Ag contained).
- Sufficient stockpile for two to three years of operation.
- An Ag recovery circuit to be installed to process initial feed.
- Commenced drilling on nearby Temagami Cobalt Property at Emerald Lake, located 40 km from the company's refinery; the goal is to define ore zones that could supplement stockpile material feed.

BINCO Nickel Exploration Project

- 165 000 ha of claims northeast of Thompson, Manitoba, held by BINCO Resources Corporation, which is wholly owned by Canmine.

- $2 million drilling program announced in late 2000 to drill 25 holes.
- BINCO Resources is to become a public company; regulatory approval is pending.

Maskwa Mine Project

- Nickel-copper-cobalt project in Manitoba with reserve plus resource consisting of 2.65 Mt @ 1.27% Ni, 0.04% Co, 0.21% Cu, 2.8 g/t Pt, and 0.96 g/t Pd (previous articles in the *Canadian Minerals Yearbook* showed tonnage incorrectly because short tons were not converted to tonnes).
- The capital cost for mine/mill development is estimated at $20 million-$60 million.
- Environmental permits from the province are required prior to construction.

Werner Lake Cobalt Mine Project

- Deposit is located in western Ontario, close to the Manitoba border; access is by road from Manitoba.
- 300-t/d underground mine operation is planned; ore is to be trucked to the Maskwa site (see above) for milling; concentrate is to be sent to Canmine's refinery in Cobalt, Ontario, for processing into cobalt carbonate.
- West Cobalt Zone reserve plus resource is estimated at 1.1 Mt @ 0.31% Co, 0.29% Cu, 0.34 g/t Au.

NORTH AMERICAN PALLADIUM LTD.

<http://www.napalladium.ca>

The company owns the Lac des Iles open-pit palladium mine/mill, located 85 km north of Thunder Bay, Ontario. Concentrate is shipped to Inco and Falconbridge in Sudbury under agreements to March 2006. Nickel is produced as a by-product of palladium mining (the ore also contains recoverable Pt, Au and Cu).

Securities filings are available on the Internet at <http://www.sedar.com/command_ servlet?cmd=DisplayCompanyDocuments&issuerNo=00003026&lang=EN>.

A Labour agreement with United Steelworkers of America-Canada, Local 9422, expires in 2006.

Ownership: The operating company, Lac des Iles Mines Ltd., is owned 100% by North American Palladium.

NORTH AMERICAN PALLADIUM

	1999	2000
	(t)	
Ni in concentrate	442	470

Mineral Inventory to Year-End 2000

- Proven + probable reserves = 96 Mt @ 1.55 g/t Pd, 0.055% Ni.
- Measured + indicated resources = 49 Mt @ 1.62 g/t Pd, 0.05% Ni.
- The mineral inventory also includes Pt, Au and Cu.

2000 Notes

- $200 million mine/mill expansion from 2400 t/d to 15 000 t/d continued.
- New 15 000-t/d mill is being built for expansion; once completed and commissioned in 2001, the 2400-t/d mill will close.
- Expansion project was 70% completed by year-end.
- The expansion is scheduled for completion in 2001 and is expected to operate at capacity in 2002.
- Long-term average production is expected to be 900 t/y Ni plus 7.78 t/y Pd, 0.7 t/y Pt, 0.65 t/y Au and 2700 t/y Cu.
- Exploration drilling continues in 15 000 ha of claims and leases within 25 km of the mine.

WORLD COBALT PRODUCTION

World cobalt mine and metal production data by country from the International Consultative Group on Nonferrous Metals Statistics for the period 1991 to 2000 are presented in Figures 3 and 4. Table 9 presents CDI information about refined cobalt availability by company for the period 1996 to 2000.

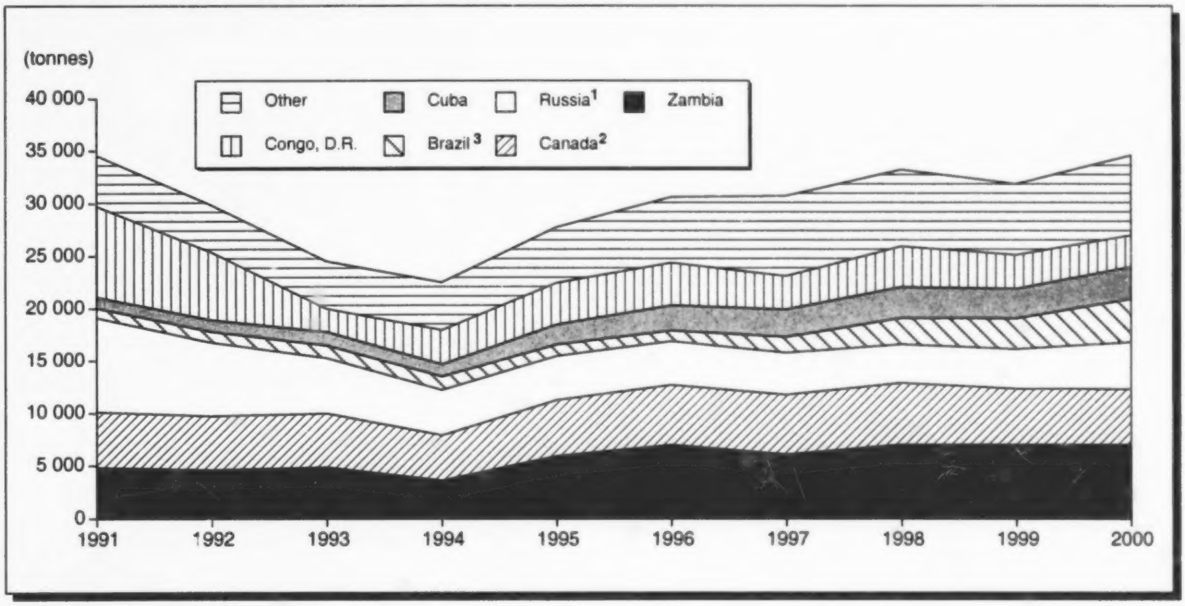
NICKEL USE

Canadian data on nickel use, including nickel in scrap, are presented in Figure 5.

The important world markets for primary nickel are shown in Figure 6. In addition to the 1.1 Mt of primary nickel used in 2000, there were approximately 600 000 t of nickel contained in stainless steel scrap used by stainless steel mills in 2000 (see "Recycling" below).

The stainless steel industry is the largest user of nickel, both in the primary and recycled forms; stainless steel production reached an estimated 18.5 Mt in 2000, up from 17 Mt in 1999.

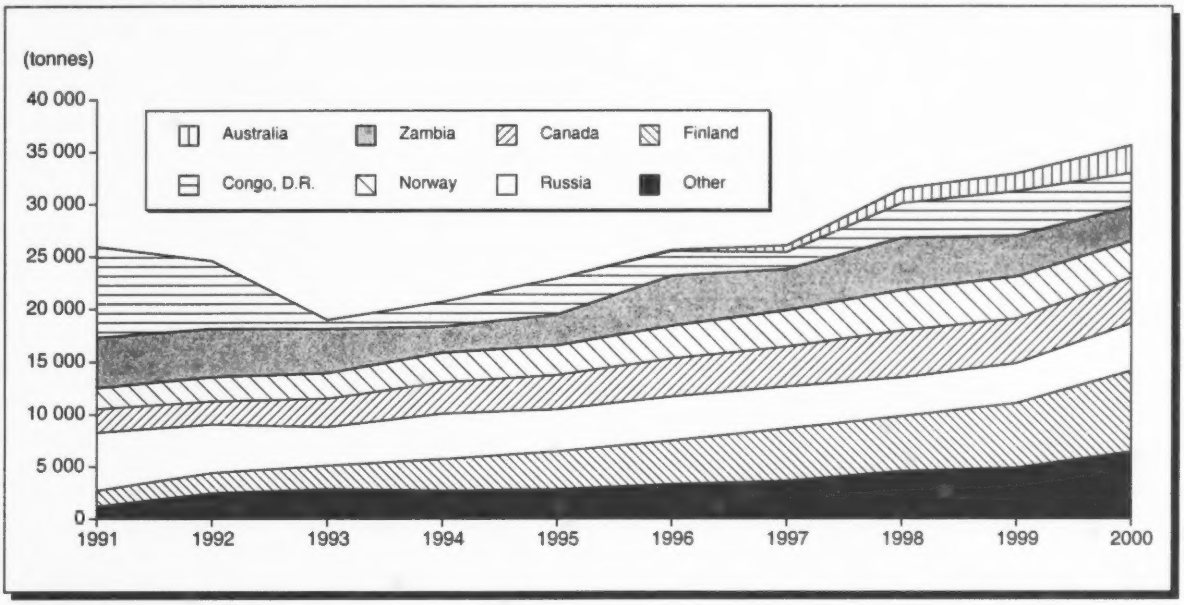
Figure 3
World Mine Cobalt Production, 1991-2000



Source: International Consultative Group on Nonferrous Metals Statistics.

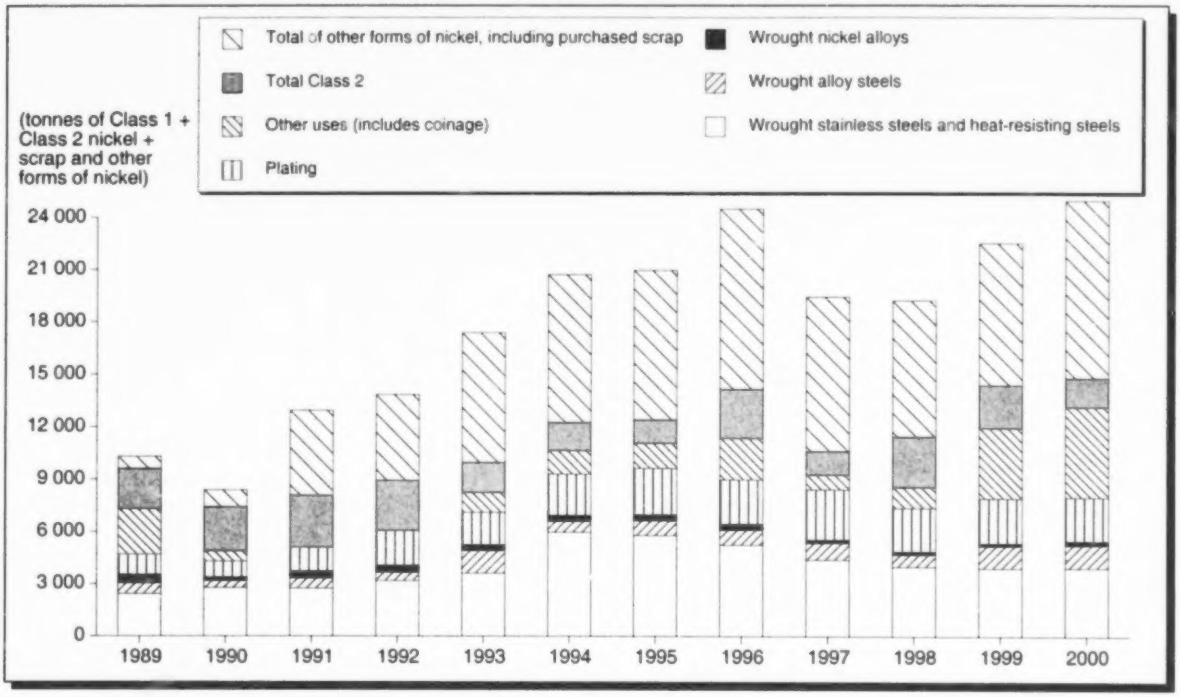
[1] Cobalt metal. [2] Cobalt content in concentrates produced. [3] Cobalt content in ores.

Figure 4
World Cobalt Metal Production, 1991-2000



Source: International Consultative Group on Nonferrous Metals Statistics.

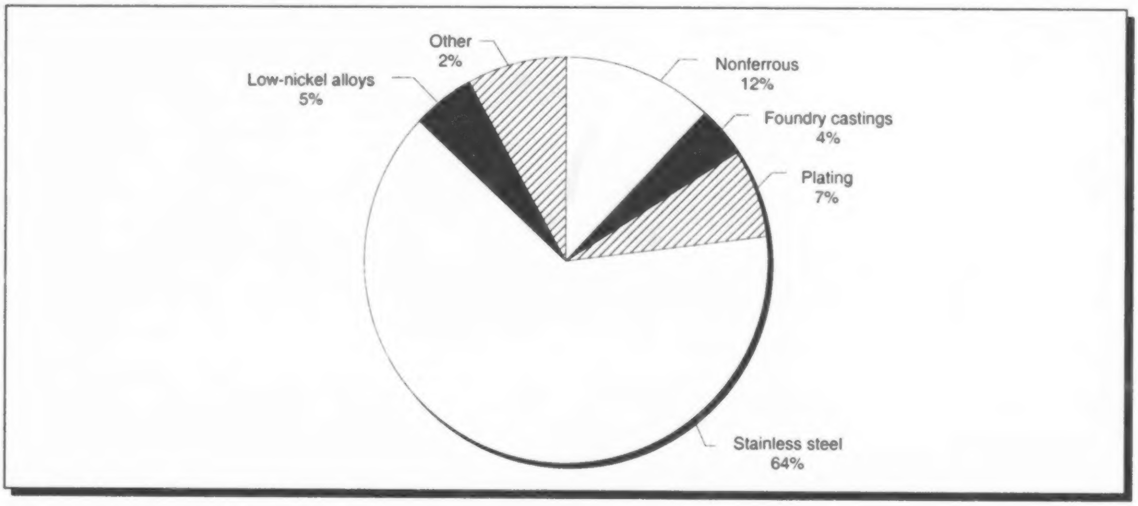
Figure 5
Canadian Use of Nickel, Including Nickel in Recycled Forms (Scrap, Etc.), 1989-2000



Source: Natural Resources Canada.

Notes: Class 1 nickel has a nickel content of more than 99% nickel. Class 2 nickel has a nickel content of less than 99% nickel.

Figure 6
Western World Nickel Use, 2000



Source: Inco Limited's 10K report, 2000.

Note: Western World excludes the Russian Federation, China, Cuba, the former Eastern Europe and the C.I.S.

Stainless steel producers can use either nickel in stainless steel scrap (which also contains needed iron and chromium) or nickel from primary producers in various forms such as nickel oxide sinter, ferro-nickel (FeNi), or high-grade finished nickel forms such as cut cathodes or briquettes.

Stainless steel producers can vary the proportion of the nickel that they use in primary or recycled forms, depending upon prices and availability of each material. Usually stainless producers can obtain a tonne of nickel in recycled material cheaper than a tonne of nickel in primary form. According to Inco Limited's 10K report for 2000, about 48% of the nickel used to make stainless steel in the Western World in 2000 was obtained from scrap, compared to 44% in 1999. Thus, the Western World stainless steel industry sourced a minimum of about 500 000 t of nickel in scrap during 2000; this compares with approximately 535 000 t of primary nickel used in the Western World to make stainless steels.

A steel is "stainless" or corrosion-resistant when it contains a minimum of 10.5% chromium by weight. A thin film of chromium oxide adheres to the surface of stainless steel; when damaged, this film is self-healing if sufficient oxygen is present. The presence of nickel gives stainless steel superb resistance to corrosion, even in harsh operating environments. The common form of stainless steel that contains nickel is called "austenitic." Its weldability characteristics are very good, making it a good choice for construction. Austenitic stainless steel has exceptional resistance to extreme temperatures. In addition, austenitic stainless steel is very easily cleaned and therefore has excellent hygienic characteristics.

Stainless steel comes in a variety of grades and types. The most common grade is A 304, composed of 18-20% chromium and 8-10.5% nickel, with almost all of the remainder as iron. While austenitic stainless steel contains nickel, ferritic stainless steel need not. A guide to these two types of stainless steel and others can be found at The Specialty Steel Industry of North America's Internet sites at <http://www.ssina.com/stainless.html> and <http://www.ssina.com/student.html>.

General information on stainless steels can be found on Outokumpu Oyj's Internet site at <http://www.outokumpu.com/steel/pprod4.htm>. Additional information is available from the International Iron and Steel Association's Internet site at <http://www.worldsteel.org/issf/issf_about/index.html>. A list of stainless steel producers and organizations can be found at <http://www.mlc.lib.mi.us/~stewarca/stainless.html>.

Stainless steel and high-nickel alloys are used in many applications, including:

- gas turbines,
- petroleum refining,
- the chemical industry,
- the food industry,
- flue gas desulphurization plants,
- liquified petroleum gas tank liners,
- cryogenic applications,
- coinage,
- electronics,
- surgical equipment and implants,
- batteries (nickel-cadmium, nickel-iron, and nickel-metal hydride cells), and
- household goods (such as cutlery, appliances, sinks, building facings and building trim).

Various car manufacturers continued their work on the development of nickel-metal hydride batteries to power electric and hybrid cars.

The term "use" replaces the term "consumption" in this publication. "Use" reflects the fact that nickel, like most metals, is not "used up" in the same manner that fuel oil, natural gas or food are "used up" when consumed. Nickel, when used, is largely available for re-use at the end of the service life of the product containing that nickel.

Stainless steel production grew at a high rate during the first half of the year and then slowed during the third quarter. By the fourth quarter, producers had cut back and the stainless industry was destocking (sales exceeded production as the stainless industry reduced inventories). With stainless steel being such a large sector for primary demand, nickel prices fell. By year-end, the outlook was negative for stainless steel growth and little chance of recovery was foreseen until the second half of the year. For example, Macquarie Research Equities calculated changes in "apparent consumption" in the United States for each quarter in 2000 compared to a year earlier; the data show the decline compared to the same periods in 1999.

Year 2000 Quarter	% Change in Apparent Use compared to Same Period in 1999	Apparent Use
	(%)	(000 t)
First	24.2	836
Second	14.1	833
Third	-7.4	703
Fourth	-25.3	620

COBALT USE

Information about cobalt uses can be obtained from: Canmine's internet site at <http://www.canmine.com/me/index.html> (click on "cobalt market"), The Cobalt Development Institute's Internet site at <http://thecdi.com>, the U.S. Geological Survey's Internet site at <http://minerals.usgs.gov/minerals/pubs/commodity/cobalt>, and the OM Group's Internet site at <http://www.omgi.com>.

At the OM Group site, click on the button marked "Select a Category"; this leads the viewer to a series of application titles (see table below). Each title can be clicked on for more information about the specific application.

Canadian cobalt use is reported in Table 2B.

HEALTH AND THE ENVIRONMENT

Nickel is a naturally occurring element that exists in bedrock, soil, groundwater, rivers and the ocean. Nickel is also believed to make up a large percentage of the earth's core and is considered to be an essential element for plants and most animals. It has been proven to be an absolute growth requirement for certain types of bacteria and algae, and nickel deficiencies in animals have been linked to growth retardation. Besides being an essential element for plants and many animals, it is the view of many experts that nickel is likely an essential element for humans as well.

The average human body contains an estimated 7-10 mg of nickel, and nickel is present in human fetal tissue. Food is the major route for nickel intake by humans. Ingestion of nickel has not been shown to be either a cause of cancer in humans or a cause of nickel sensitivity. The principal health risks associated with oxidic, sulphidic and soluble nickel compounds include lung or nasal cancer and contact dermatitis.

Nickel dermatitis is caused through long-term direct or indirect contact of the skin with certain nickel-containing items that can dissolve in sweat and penetrate the skin. It is estimated that 10-20% of women and 1-2% of men are "sensitive" to nickel, with nickel dermatitis being one of the principal adverse health effects. However, many nickel alloys, including stainless steel, do not react with sweat and therefore do not cause a nickel allergy.

In the past, increased rates of lung and nasal cancers were experienced by personnel employed in certain dusty nickel-processing facilities where most of the workers involved were also exposed to many other substances in the dust (in some cases, arsenic, and where tobacco smoking was a compounding factor).

More information about nickel-specific health issues can be found at the Nickel Producers Environmental Research Association (NiPERA) Internet site at <http://nipera.org>.

In April, in the United States, the National Toxicology Program announced its intention to review certain materials for possible listing in its *Report on Carcinogens, Tenth Edition*. Nickel and nickel compounds, including metallic nickel and nickel alloys, were named in a list that also contained lead and lead compounds, broad spectrum UV radiation, and wood dust. Public comments were received during the year. More information is available on the Internet at <http://ntp-server.niehs.nih.gov>.

RECYCLING

Nickel is an element that is intensively recycled. This recycling is driven by economic incentives, not government subsidies. The major competitor for primary nickel's biggest market, stainless steel-making, is nickel in scrap. In the Western World, Inco estimated that about 48% of the nickel needed by the austenitic stainless steel industry is obtained in the form of stainless steel scrap. Stainless steel scrap not only contains nickel, but also chrome and iron, which are needed to produce austenitic stainless steel.

COBALT APPLICATIONS

Batteries/Rechargeable Cells
Bushings & Bearings
Ceramics & Glassware
Chemicals for Electronics and Engineered Applications
Chemicals for Heat Stabilizers
Coatings
Cobalt & Tungsten Powders
Construction Equipment
Copper Powders
Diamond Tools
Driers
Fuel Additives
Heat Stabilizers
Lubricant Additives
Metal Finishing
Metal Spraying & Welding
Metal Surfacing
Petrochemical Refining
Polyester Catalysts
Pressed Metal Parts
Printed Circuit Boards
Printing Inks
Solder Pastes
Synthetic Fibres
Tires

Source: Applications listed above are from http://www.omgi.com, where more information is available.

About three quarters of the stainless steel produced is austenitic, with the remaining one quarter called "ferrritic stainless," which does not contain nickel.

Approximately 65% of the primary nickel used in the Western World in 2000, or about 670 000 t, goes to make austenitic stainless steels. Using a 52%:48% ratio of primary to recycled nickel used in austenitic stainless steels implies that the Western World used just over 615 000 t of nickel contained in scrap to make austenitic stainless steels. It is difficult to estimate the scrap usage in other parts of the world. If one can conservatively assume that world scrap usage were only 615 000 t, total world nickel usage for 2000 would be 1 127 000 t of nickel from primary sources and 615 000 t of nickel from recycled sources, or a total of 1 742 000 t of nickel from primary plus recycled sources. Thus, about 35% of total (primary plus recycled) nickel used in 2000 was sourced from recycled materials, but this does not mean that the recycling rate of nickel was only 35%; in fact, it was higher.

To calculate a recycling rate, one needs to know the product life for the materials used in goods. Then the production from decades earlier could be related to the recycled nickel in a current year. Stainless steel is used in relatively long-life applications due to its higher initial cost and lower maintenance costs over its years in service. So this means that there is a long period of time between the production of the nickel-containing stainless steel and its recycling. But, during that time, demand has grown (and thus production). At a 6% growth rate, stainless steel demand more than quadruples in 25 years. If all the nickel in stainless steels produced in one year were to be recycled after 25 years, the recycling of 100% of that material would only represent 25% of the nickel being used to make stainless steel. So in this case, 100% recycling would translate into a feed ratio of only 25% recycled material if all scrap were sourced only from used consumer and industrial goods (i.e., no new scrap from fabrication being used in this example) to the extent that new scrap or "blended scraps" (using primary nickel mixed with scrap iron) are being used. Thus, one can conclude that recycling rates are higher than the ratio of recycled feed to total feed, but calculating the true recycling rate is difficult.

PRICES AND STOCKS

Cash settlement prices for nickel on the London Metal Exchange (LME) averaged US$8641/t (US$3.92/lb), continuing the rise from the low of December 1998 to peak at US$10 660/t (US$4.84/lb) on March 7. Prices then declined to as far as US$9360/t, before running up to US$10 600/t in May prior to the announcement of a labour agreement between Inco and the union locals representing workers in Sudbury and Port Colborne. Thereafter, prices trended downward through the year as the stainless steel industry could not maintain its momentum of 1999. Figure 2 shows prices in 2000 and for the period 1990 to 2000.

LME inventories declined from 46 908 t at the start of the year to 9678 t at year-end.

Current and historical nickel prices and stocks are available on the LME's Internet site at <http://www.lme.co.uk>. Another site for nickel prices is <http://www.metalalloys.com>.

Cobalt

Cobalt prices on a monthly basis are shown in Figure 7. No terminal markets such as the LME exist for cobalt, although WMC Limited reports trading on its Internet site at <http://www.wmc.com> (click on the tab "Nickel," then from the new screen choose "WMC COSS," and then choose "Market News & Commentary").

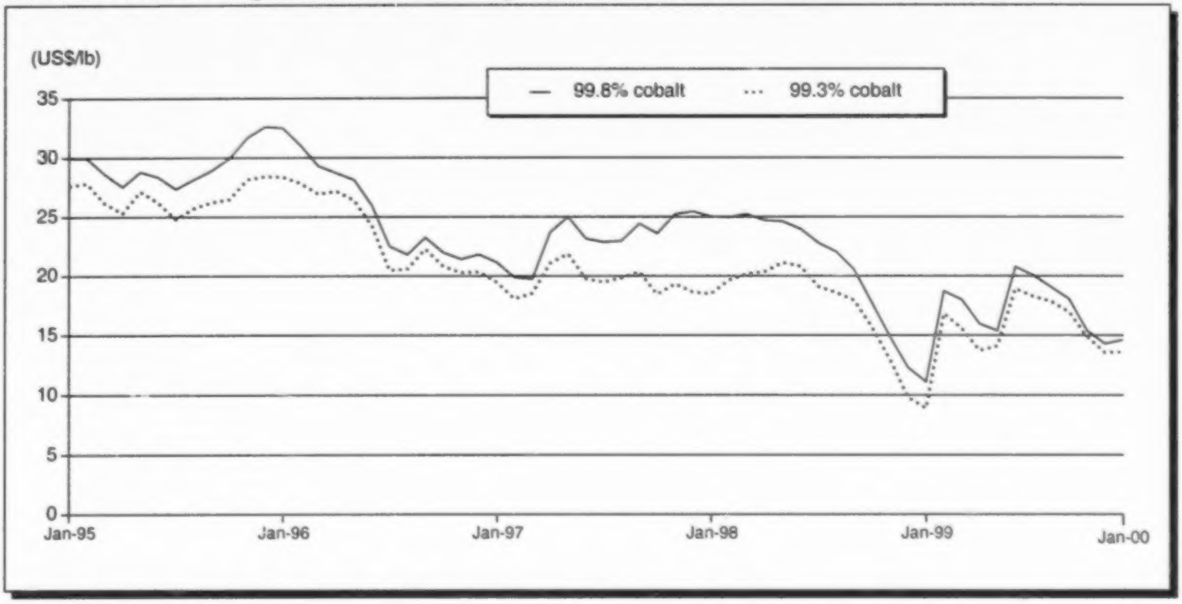
OUTLOOK

The outlook for nickel demand is a function of the industrial activity of the major countries in the world. The largest user of nickel, both primary and recycled, is the stainless steel industry, whose use is strongly correlated with indices of industrial production (see the Nickel chapter of the 1999 *Canadian Minerals Yearbook*, Figure 5, for a graph illustrating the relationship).

The demand for primary nickel is expected to grow at an average trend rate of 3%/y or less during the next decade. The actual demand in any year will vary about the trend, due primarily to changes in world industrial activity, which cause changes in stainless steel demand. It is suggested that a sustained period of prices in the US$8500/t range would decrease the competitiveness of a significant portion of austenitic stainless steel production, which in turn would lead to decreased demand growth for nickel.

The performance of the Australian operations continues to be disappointing to date (from the viewpoint of those who operated, financed and owned the facilities). These problems, the long and slow ramp-up of Murrin Murrin, and the financial woes of the Bulong and Cawse projects have slowed plans to start up new laterite operations elsewhere, with the exception of Inco's Goro project. A success at Anaconda Nickel's Murrin Murrin, for example, or a successful start-up of the Goro project is expected to re-invigorate the appetite for financing and constructing new laterite nickel projects.

Figure 7
Cobalt Prices, Average of Metal Bulletin High and Low Prices, 1995-2000



Source: Metal Bulletin monthly averages.

Nickel price volatility is also expected to continue, with price levels dependent upon world economic activity. For that reason, a series of annual prices by year is not forecasted here, but it is suggested the probable average annual prices will fall over the next 15 years and will be within a range of US$8800-$4400/t (US$4-$2/lb) with the caveat that successes of new technologies and building new laterite capacity should result in the lower price boundary of the forecast range declining over time, to perhaps US$3310/t (US$1.50/lb).

The prices noted above are current prices, not inflation-adjusted prices (assuming that the U.S. currency maintains its current strength relative to other major currencies). Nickel prices are not expected to vary with inflation; technological advances are expected to more than overcome inflationary pressures. In fact, if stainless steels and other nickel-containing products are to grow at high compound rates, then nickel prices will need to continue to drop faster than the rate of inflation to allow stainless steel and other nickel-containing products to penetrate new markets.

Cobalt

Cobalt prices (Figure 7) are trending lower, due in part to increasing nickel production from nickel-cobalt deposits. The expectation is that decisions to proceed with a number of new hydrometallurgical nickel-cobalt laterite plants would further depress cobalt prices in the medium term. However, a lower price would allow cobalt to be used economically in other applications for which it is presently too expensive. The high prices of the mid-1990s would be very difficult to sustain in the future, given present conditions and expectations.

ADDITIONAL SOURCES OF INFORMATION

Readers may access various additional sources of information on the Internet to obtain more details about nickel in general. A search engine, such as Google <www.google.com> is a good way to start to find such information. A few sites for additional information include:

Natural Resources Canada

Yearbook articles:
  http://www.nrcan.gc.ca/mms/cmy/CMY_E3.html
Metal and mineral statistics:
  http://www.nrcan.gc.ca/mms/efab/mmsd/
Nickel production by month:
  http://www.nrcan.gc.ca/ms/efab/data/default.html
Production by province:
  http://www.nrcan.gc.ca/mms/efab/mmsd/production/production.htm

Physical/Chemical Properties of Nickel

http://www.webelements.com/webelements/elements/text/Ni/key.html

Physical/Chemical Properties of Cobalt

http://www.webelements.com/webelements/elements/text/Co/key.html

WMC Market News and Commentary

http://www.wmc.com
(Click on "Nickel" tab below globe, choose "WMC NIMS," then "Market News.") Provides market information and industry developments (hundreds of items of market information for 1999 onward).

International Nickel Study Group

http://www.insg.org/

U.S. Geological Survey

Comprehensive commodity reviews:
http://minerals.usgs.gov/minerals/pubs/commodity/

Yahoo Search of Mining News

http://biz.yahoo.com/news/mining.html
(Scroll to the bottom of the page and put the word "nickel" into "Search News".)

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65 of the Canadian Minerals Yearbook. (2) Information in this review was current as of November 30, 2001. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States	EU	Japan[1]	Brazil	India	Taiwan	Korea[2]
		MFN	GPT	USA	Canada	MFN	WTO	MFN	MFN	MFN	MFN
2604.00	Nickel ores and concentrates	Free	Free	Free	Free	Free	Free	5%	5%	Free	1%
2825.40	Nickel oxides and hydroxides	Free	Free	Free	Free	Free	4.8%	5-13%	35%	2.5%	8%
7202.60	Ferronickel	6.5%	Free	Free	Free	Free	3.3%	9%	25%	Free	3%
7501.10	Nickel mattes	Free	Free	Free	Free	Free	Free	9%	15%	Free	1%
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy	Free	Free	Free	Free	Free	Free-44 yen/kg[3]	9%	15%	Free	1-2%
7502.10	Unwrought nickel, not alloyed	Free	Free	Free	Free	Free	44 yen/kg	9%	15%	1.25%	3%
7502.20	Unwrought nickel alloys	Free	Free	Free	Free	Free	Free-3%[4]	9%	15%	1.25%	3%
7503.00	Nickel waste and scrap	Free	Free	Free	Free	Free	Free	5%	15%	Free	1%
7504.00	Nickel powders and flakes	Free	Free	Free	Free	Free	Free-41 yen/kg-3%	9%	15%	Free	5%
7505.11	Bars, rods and profiles of nickel, not alloyed	Free	Free	Free	Free	Free	3%	15%	15%	2.5%	5%
7505.12	Bars, rods and profiles of nickel alloys	Free	Free	Free	Free	2.9%	3%	15%	15%	2.5%	5%
7505.21	Nickel wire, not alloyed	Free	Free	Free	Free	Free	3%	15%	15%	1.25%	5%
7505.22	Wire of nickel alloys	Free	Free	Free	Free	2.9%	3%	15%	15%	1.25%	5%
7506.00	Nickel plates, sheets, strip and foil	Free	Free	Free	Free	Free-3.3%	Free-3%	15%	15%	2.5%	5%
7507.00	Nickel tubes, pipes, and tube or pipe fittings	Free	Free	Free	Free	Free-2.5%	Free-3%	17%	15%	2.5%	8%
7508.00	Other articles of nickel	Free-3%	Free	Free	Free	Free	3%	19%	15%	1.25-5%	8%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; Worldtariff *Guidebook on Customs Tariff Schedules of Import Duties for European Union* (40th Annual Edition: 2000); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Brazil* (7th Annual Edition: 2000); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of India* (7th Annual Edition: 2000); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Korea* (7th Annual Edition: 2000); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Taiwan* (5th Annual Edition: 2000); *Customs Tariff Schedules of Japan*, 2000.

[1] WTO rate is shown; lower tariff rates may apply circumstantially. [2] South Korea. [3] Free except for nickel oxide sinters containing by weight not less than 88% nickel, for which the tariff rate is 44 yen/kg, and nickel oxide containing by weight not more than 1.5% copper, for which the tariff rate is 3%. [4] The tariff rate of 3% applies to nickel alloys other than those containing by weight less than 50% nickel and not less than 10% cobalt.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2605.00	Cobalt ores and concentrates	Free	Free	Free	Free
2822.00	Cobalt oxides and hydroxides, commercial cobalt oxides	Free	Free	Free	Free
2827.34	Cobalt chloride	4%	3%	Free	Free
2833.29.00.40	Cobalt sulphate	Free	Free	Free	Free
2836.99.10.30	Cobalt carbonates for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics; cobalt carbonates to be employed as drilling mud or additives in drilling for minerals, natural gas, oil or water	Free	Free	Free	Free
2836.99.90.20	Other cobalt carbonates	3.5%	3%	Free	Free
2915.23.10	Cobalt acetates for use as petroleum refining catalysts, or for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics	Free	Free	Free	Free
2915.23.90	Other cobalt acetates	8%	3%	Free	Free
8105.10	Cobalt mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; waste and scrap; powders				
8105.10.10	Cobalt waste and scrap fit only for remelting and recovery of the metal content; powders; unwrought cobalt, not alloyed	Free	Free	Free	Free
8105.10.90	Other	3%	Free	Free	Free
8105.90.10	Cobalt bars and rods, not alloyed	3%	Free	Free	Free
8105.90.90	Cobalt and articles thereof, n.e.s.	3%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.
n.e.s. Not elsewhere specified.

TABLE 1a. CANADA, NICKEL PRODUCTION AND TRADE, 1999 AND 2000

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
MINE OUTPUT	(Nickel content of ore milled in 2000)	186 236	. .	190 727	. .
PRODUCTION[1]	(Recoverable nickel content in concentrates shipped in 2000)				
	All forms				
	Quebec	19 402	174 737	22 898	298 205
	Ontario	126 575	1 139 931	114 350	1 489 186
	Manitoba	30 773	277 137	43 778	570 127
	Total Canada	176 749	1 591 805	181 027	2 357 518
	Finished nickel output (refined nickel in various shapes in Class I, plus Class II nickel [as defined by the International Nickel Study Group], which includes nickel oxide sinter)	124 260	. .	134 225	. .
EXPORTS					
2604.00.40	Nickel ores and concentrates, nickel content	–	–	–	–
2620.90	Ash and residue which is known to contain nickel[2]				
	United States	213 791	123 797	127 571	85 794
	United Kingdom	–	–	. . .	3 841
	Other countries	92	5 892	21	25
	Total	213 883	129 689	127 592	89 660
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Hong Kong	479	5 999	954	10 622
	Malaysia	9	114	85	1 054
	United States	21	248	75	1 052
	Singapore	95	1 043	71	968
	Other countries	49	423	33	293
	Total	653	7 827	1 218	13 989
2827.35	Nickel chlorides (weight of material, not nickel content)	–	–	–	–
2833.24	Nickel sulphates (weight of material, not nickel content)				
	United Kingdom	304	2 906	332	1 752
	Other countries	36	120	95	299
	Total	340	3 026	427	2 051
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	United States	126	1 074	28	157
	Other countries	1	114	–	–
	Total	127	1 188	28	157
7202.60	Ferronickel	–	–	–	–
7204.21	Stainless steel waste and scrap (weight of material, not nickel content)				
	United States	44 762	24 293	31 267	27 019
	Spain	7 618	5 992	5 593	6 498
	India	396	455	1 363	1 308
	Other countries	3 271	2 562	1 777	2 482
	Total	56 047	33 302	40 000	37 307
7501.10	Nickel mattes (nickel content)				
	Norway	51 799	434 836	41 031	572 078
	United Kingdom[3]	39 467	268 339	30 218	384 899
	Other countries	247	1 636	21	105
	Total	91 513	704 811	71 270	957 082

TABLE 1a (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy (weight of material, not nickel content)				
	United States	4 189	30 044	3 225	39 714
	Taiwan	1 135	9 085	1 434	11 530
	South Korea	5 764	43 869	1 105	9 217
	Belgium	649	4 947	936	8 913
	Total	11 737	87 945	6 700	69 374
7502.10	Nickel unwrought, not alloyed (nickel content)				
	United States	45 342	362 735	52 132	662 659
	Belgium	7 354	54 467	10 295	135 500
	Hong Kong	3 400	28 579	6 511	88 106
	Italy	7 570	66 038	6 382	82 225
	Taiwan	3 609	25 914	3 761	51 800
	Netherlands	6 345	58 306	3 844	48 167
	Japan	2 684	19 235	2 973	39 457
	Singapore	1 072	8 106	2 287	30 795
	United Kingdom	1 620	13 587	2 340	29 384
	Other countries	7 848	61 398	4 591	60 123
	Total	86 844	698 365	95 116	1 228 216
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	Hong Kong	–	–	1 891	25 871
	United States	203	1 502	217	3 034
	Other countries	–	–	1 784	22 989
	Total	203	1 502	3 892	51 894
7503.00	Nickel waste and scrap (weight of material, not nkckel content)				
	United States	3 010	9 329	5 100	34 103
	Japan	137	817	521	3 675
	Other countries	21	32	36	97
	Total	3 168	10 178	5 657	37 875
7504.00	Nickel powders and flakes, alloyed and unalloyed (weight of material, not nickel content)				
	United States	5 744	85 128	6 470	109 649
	Japan	5 156	46 382	2 276	30 857
	Netherlands	417	3 648	250	3 519
	United Kingdom	168	4 032	24	2 873
	Other countries	1 951	26 383	386	6 446
	Total	13 436	165 573	9 406	153 344
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)	–	–	–	–
7505.12	Bars, rods and profiles of nickel alloy (weight of material, not nickel content)				
	Poland	1	13	1	13
	United Kingdom	1	22	1	10
	Other countries	2	151	2	42
	Total	4	186	4	65
7505.21	Nickel wire, not alloyed (weight of material including coating, if any, not nickel content)				
	United States	11	294	11	289
	Total	11	294	11	289
7505.22	Wire, nickel alloy (weight of material, not nickel content)				
	United States	13	303	30	662
	Taiwan	–	–	20	148
	United Kingdom	4	138	3	42
	Germany	–	–	2	40
	Total	17	441	55	892

TABLE 1a (cont'd)

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7506.00[a]	Nickel plates, sheets, strip and foil (weight of material, not nickel content)				
	United States	27	278	3	44
	Poland	1	19	1	17
	Libyan Arab Jamahiriya	10	100	1	2
	Other countries	4	30	–	5
	Total	42	427	5	68
7507.00[b]	Nickel tubes, pipes, and tube or pipe fittings, alloyed and unalloyed (weight of material, not nickel content)				
	United States	. .	2 909	. .	3 294
	Germany	. .	136	. .	159
	Netherlands	–	–	. .	78
	Other countries	. .	227	. .	257
	Total	. .	3 272	. .	3 788
7508.00	Other articles of nickel (weight of material, not nickel content)				
	United States	. .	10 464	. .	10 236
	China	. .	16	. .	337
	Germany	. .	51	. .	100
	Other countries	. .	489	. .	301
	Total	. .	11 020	. .	10 974
	Total exports		1 729 357		2 567 365
IMPORTS[4]					
2604.00.00.20	Nickel ores and concentrates, nickel content				
	United States	929	5 834	1 146	7 207
	Germany	2	15	5	46
	Other countries	3	17	. . .	1
	Total[5]	934	5 866	1 151	7 254
2620.90	Ash and residue that is known to contain nickel[2]				
	Cuba[6] (weight of material, not nickel content; material also includes significant cobalt value; hence the value of imported nickel calculated below is too high)	55 576	242 456	54 865	361 717
	Total	55 576	242 456	54 865	361 717
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Finland	392	5 173	365	5 409
	United States	1 723	394	3 119	1 174
	Other countries	1	9	238	139
	Total	2 116	5 576	3 722	6 722
2827.35	Nickel chlorides (weight of material, not nickel content)				
	United States	32	221	116	736
	France	44	262	146	626
	Other countries	16	105	. . .	1
	Total	92	588	262	1 363
2833.24	Nickel sulphates (weight of material not nickel content)				
	United States	83	591	544	4 173
	Other countries	359	848	627	3 274
	Total	442	1 439	1 171	7 447

TABLE 1a (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	United States	1 851	17 251	1 062	14 645
	Other countries	333	5 422	420	7 494
	Total	2 184	22 673	1 482	22 139
7202.60	Ferronickel (weight of material, not nickel content)				
	United States	30	158	54	289
	Total	30	158	54	289
7204.21	Stainless steel scrap (weight of material, not nickel content)				
	United States	28 000	26 260	46 699	44 105
	China	423	556	395	405
	Other countries	45	27	77	80
	Total	28 468	26 843	47 171	44 590
7501.00c	Nickel mattes, nickel oxide sinters and other intermediate products of nickel metallurgy (weight of material, except for matte, which is nickel content)				
	Australia[7]	3 125	16 566	5 234	30 529
	United States	1 913	3 680	2 363	6 791
	Germany	–	–	1 198	1 697
	Other countries	499	1 614	1 260	5 365
	Total	5 537	21 860	10 055	44 382
7502.10	Nickel unwrought, not alloyed (nickel contenet)				
	Norway	952	8 044	1 159	13 689
	United States	102	781	351	4 373
	Finland	271	2 327	243	3 424
	United Kingdom	248	2 036	124	1 258
	Other countries	788	5 388	251	2 735
	Total	2 361	18 576	2 128	25 479
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	United States	189	1 260	339	2 395
	Bermuda	547	3 077	258	1 418
	United Kingdom	207	1 021	102	1 008
	Germany	2	21	406	662
	Other countries	73	422	22	159
	Total	1 018	5 801	1 127	5 642
7503.00	Nickel waste and scrap (weight of material, not nickel content)				
	United States	18 385	40 415	17 926	48 612
	Russia	–	–	1 014	5 617
	Germany	171	680	601	1 871
	United Kingdom	704	2 621	354	1 413
	Venezuela	–	–	156	991
	Other countries	1 289	6 904	473	2 670
	Total	20 549	50 620	20 524	61 174
7504.00	Nickel powder and flakes alloyed and unalloyed (weight of material, not nickel content)				
	Australia	912	8 356	1 074	13 558
	United States	260	3 886	460	5 138
	Belgium	9	160	159	1 894
	Germany	10	205	296	1 779
	Other countries	394	4 220	126	1 634
	Total	1 585	16 827	2 115	24 003

TABLE 1a (cont'd)

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)				
	United States	26	399	10	166
	Other countries	1	36	. . .	9
	Total	27	435	10	175
7505.12	Bars, rods and profiles of nickel alloys (weight of material, not nickel content)				
	United States	406	9 186	981	20 343
	Germany	33	634	84	1 462
	Other countries	11	203	9	173
	Total	450	10 023	1 074	21 978
7505.21	Nickel wire, not alloyed (weight of nickel wire plus coating, if any)				
	United States	95	1 051	79	859
	Gemany	6	75	19	240
	Other countries	59	546	20	171
	Total	160	1 672	118	1 270
7505.22	Wire, nickel alloy (weight of alloy plus coating, if any, not nickel content)				
	United States	302	5 859	350	6 770
	Germany	70	1 176	115	2 027
	Other countries	91	1 275	138	1 882
	Total	463	8 310	603	10 679
7506.00	Nickel plates, sheets, strip and foil, alloyed and unalloyed (if alloyed, weight of material and not nickel content)				
	Germany	1 099	5 849	1 103	22 066
	United States	651	13 340	624	12 949
	Other countries	130	1 431	50	968
	Total	1 880	20 620	1 777	35 983
7507.00	Nickel tubes, pipes, and tube or pipe fittings, alloyed and unallyed (weight of material and not nickel content)				
	Japan	259	9 108	633	21 452
	United States	429	9 344	577	12 681
	United Kingdom	69	1 775	200	3 832
	Norway	218	2 313	200	2 797
	Other countries	198	5 624	54	1 115
	Total	1 173	28 164	1 664	41 877
7508.00	Other articles of nickel (weight of material, not content)				
	United States	463	8 930	858	12 431
	France	114	1 275	311	1 813
	United Kingdom	39	649	42	701
	Other countries	131	1 271	105	1 352
	Total	747	12 125	1 316	16 297
	Total Imports		500 632		740 460
	Net Imports of nickel		1 228 725		1 826 905

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; [p] Preliminary; [r] Revised.
[a] Included in the data are HS codes 7506.10 and 7506.20. [b] Included in the data are HS codes 7507.11, 7507.12 and 7507.20.
[c] Included in the data are HS codes 7501.10 and 7501.20.
[1] Recoverable nickel in concentrates shipped. [2] Nickel and cobalt are in the mixture, which is an artificial nickel-cobalt sulphide made from nickel-cobalt oxides mined in Cuba. [3] Shipments to the United Kingdom are under investigation to determine if HS 7501.20 would be a more appropriate classification. [4] Imports from "Other countries" may include re-imports from Canada. [5] No imports of nickel concentrate recorded for 2000; Jubilee Mines NL in Australia lists three shipments to Canada during 2000 of which two may have arrived during the calendar year; trade data are under investigation. [6] The International Nickel Study Group reported Canadian imports of nickel-cobalt sulphides from Cuba of 55 576 t in 1999 and 54 865 t in 2000. [7] Imports of nickel ores and concentrates occurred in 2000 according to Jubilee Mines NL and an investigation of matte imports and ores and concentrate imports from Australia in 2000 is under way.
Note: Numbers may not add to totals due to rounding.

TABLE 1b. CANADA, NICKEL PRODUCTION AND USE, 1970, 1975, 1980 AND 1985-2000

	Production[1] (Mine Output)	Use[2]
	(tonnes)	
1970	277 490	10 699
1975	242 180	11 308
1980	184 802	9 676
1985	169 971	7 206
1986	163 640	8 865
1987	193 391	9 732
1988	216 589	9 250
1989	200 899	10 421
1990	196 225	8 410
1991	192 259	13 322[a,r]
1992	186 384	15 528[r]
1993	188 080	17 384[a,r]
1994	149 886	20 746[r]
1995	181 820	20 973[r]
1996	192 649[r]	24 504[r]
1997	180 624[r]	19 447
1998	197 947[r]	19 787[r]
1999	176 749	22 527[r]
2000[p]	181 027	24 976[r]

Source: Natural Resources Canada.

. . Not available; [p] Preliminary; [r] Revised.

[a] Increase in number of companies being surveyed.

[1] Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported. Data for 1987-2000 are nickel contained in concentrates produced.

[2] Use of metallic nickel, all forms (refined metal, nickel in ferronickel oxides and salts, and other forms of nickel including nickel in purchased scrap) as reported by users on the Natural Resources Canada survey "Consumption of Nickel."

Note: Metals are used in industrial and consumer applications; unlike fuel oil or agricultural commodities, metals are not "used up" or "consumed"; instead, they are recycled. Discussions taking place in international fora indicate that the term "consumption" should be changed to more appropriately reflect actual practice. For this reason, the word "use" has replaced "comsumption" in this chapter, where appropriate.

TABLE 1c. CUPRONICKEL, NICKEL-SILVER, STAINLESS STEELS, AND NICKEL-CADMIUM AND NICKEL-IRON BATTERIES, 1999 AND 2000

	1999		2000p	
	(tonnes)	($000)	(tonnes)	($000)
STAINLESS STEEL SEMI-FABRICATED ITEMS (excludes scrap)				
Exports – Total for Each HS Class				
7204.29	111 738	18 500	162 737	33 113
7210.9	759	1 181	2 591	3 977
7220.2	2 568	9 498	3 004	11 652
7222.11	3 373	7 939	6 052	12 855
7222.19	18	116	79	270
7222.2	8 624	36 136	12 627	56 023
7222.3	1 503	7 134	139	526
Total exports	128 583	80 504	187 229	118 416
Imports – Total for Each HS Class				
7204.29	225 961	54 213	203 380	59 288
7210.9	8 622	19 711	6 925	15 485
7212.50.90.13	3 811	9 222	3 078	7 192
7222.11	28 468	26 843	47 171	44 590
7222.19	2 520	10 344	3 106	13 191
7222.20.10	59	367	39	212
7222.20.90	7 344	30 240	11 623	45 323
7222.30.00.11	220	1 441	282	1 815
7222.30.00.19	4	22	12	44
Total imports	277 009	152 403	275 616	187 140
Net exports of stainless steels	-148 426	-71 899	-88 387	-68 724
CUPRO-NICKEL AND NICKEL-SILVER SEMIFABRICATED GOODS (nickel-silver is a copper-nickel-zinc alloy)				
Exports – Total for Each HS Class				
7403.23	–	–	81	346
7407.22	77	450	82	580
7408.22	21	499	24	320
7409.40	948	5 749	5 237	70 661
7411.22	2 764	18 907	2 809	21 570
Total exports	3 810	25 605	8 233	93 477
Imports – Total for Each HS Class				
7403.23.00.10 to 7403.23.00.40	13	50	218	736
7407.22.11 to 7407.22.29.10	64	298	51	250
7408.22.10 to 7408.22.90.30	455	1 168	372	939
7409.40.00.11 to 7409.40.00.40	5 018	24 059	2 477	10 052
7411.22.00.10 to 7411.22.00.30	530	3 542	391	2 508
Total imports	6 080	29 117	3 509	14 485
Net exports of cupro-nickel and nickel-silver	-2 270	- 3 512	4 724	78 992

ELECTRIC ACCUMULATORS
(nickel-cadmium and nickel iron batteries)

	1999	2000
	($000)	($000)
Exports – Total for Each HS Class		
Ni-Cd batteries 8507.30	1 527	5 188
Ni-Fe batteries 8507.40	7 181	10 159
Total exports	8 708	15 347
Imports – Total for Each HS Class		
Ni-Cd batteries 8507.30	70 333	61 950
Ni-Fe batteries 8507.40	4 481	3 026
Total imports	74 814	64 976
Net exports of Ni-Cd and Ni-Fe batteries	-66 106	-49 629

Source: Natural Resources Canada.
– Nil.

TABLE 2a. CANADA, COBALT PRODUCTION AND TRADE, 1999 AND 2000, AND USE, 1998-2000

Item No.		1999		2000[p]	
		(kilograms)	($000)	(kilograms)	($000)
MINE OUTPUT	(Cobalt content of ore milled in 2000)	5 322 562		5 281 125	
PRODUCTION[1]	(Recoverable cobalt in concentrates shipped)				
	Quebec	189 104	10 543	220 000	11 047
	Ontario	1 522 247	84 873	1 359 539	68 269
	Manitoba	302 546	16 868	433 408	21 764
	Total	2 013 897	112 285	2 012 947	101 080
	Refined[2]	3 972 051	. .	4 090 989	. .
EXPORTS					
2605.00	Cobalt ores and concentrates (cobalt content)	9 553	21	–	–
	Total	9 553	21	–	–
2822.00	Cobalt oxides and hydroxides; commercial cobalt oxides (weight of material, not cobalt content)				
	United Kingdom	223 916	8 599	327 651	10 457
	South Africa	–	–	5 480	115
	United States	101	7	1 364	83
	Taiwan	–	–	6	. . .
	Total	224 017	8 606	334 501	10 655
2915.23	Cobalt acetates	–	–	–	–
8105.10	Cobalt, mattes and other intermediate products of cobalt metallurgy, unwrought cobalt, waste, scrap and powders (cobalt content of unwrought and mattes, and powders; weight of material for intermediates, alloys and waste and scrap)				
	Norway	2 256 812	86 533	1 487 194	59 047
	Japan	1 142 871	56 871	1 193 306	58 712
	United States	839 008	38 116	864 884	37 638
	Netherlands	794 800	41 259	464 600	23 175
	Singapore	483 300	26 464	304 000	14 879
	Other countries	764 420	32 380	558 355	24 176
	Total	6 281 211	281 623	4 872 339	217 627
8105.90	Cobalt and articles thereof, n.e.s.				
	United States	14 999	2 967	12 220	3 238
	Germany	10 443	1 903	12 950	2 290
	Brazil	–	–	401	78
	United Kingdom	370	99	385	68
	Other countries	380	65	2 842	145
	Total	26 192	5 034	28 798	5 819
	Total exports	6 540 973	295 284	5 235 638	234 101
IMPORTS					
2605.00	Cobalt ores and concentrates (cobalt content)				
	Switzerland	–	–	376 950	3 494
	Germany	71 964	825	40 697	576
	Other countries[3]	11 374	526	88 724	3 282
	Total	83 338	1 351	506 371	7 352
2822.00.00.10	Cobalt hydroxides (weight of material, not cobalt content)				
	United States	10 434	500	25 133	1 323
	Other countries	109	6	4 726	273
	Total	10 543	506	29 859	1 596
2822.00.00.20	Cobalt oxides (weight of material, not cobalt content)				
	Belgium	30 625	1 599	35 750	1 401
	Finland	54 976	2 173	14 790	486
	South Korea	–	–	5 111	225
	United States	16 064	692	3 319	143
	Other countries	29	1	2	. . .
	Total	101 694	4 465	58 972	2 255

TABLE 2a (cont'd)

Item No.		1999		2000p	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
2822.00.00.30	Commercial cobalt oxides (weight of material, not cobalt content)				
	Belgium	–	–	10 650	437
	United Kingdom	748	14	2 811	57
	United States	1 486	30	335	6
	Total	2 234	44	13 796	500
2827.34	Cobalt chlorides (weight of material, not cobalt content)				
	United States	16 878	305	45 287	668
	Other countries	21	. . .	89	2
	Total	16 899	305	45 376	670
2833.29.00.40	Cobalt sulphate (weight of material, not cobalt content)				
	United States	24 576	485	21 670	396
	Finland	14 648	249	14 557	141
	France	540	5	500	2
	Other countries	4 721	66	26	. . .
	Total	44 485	805	36 753	539
2836.99.10.30	Cobalt carbonates (weight of material, not cobalt content)				
	Finland	. .	24	. .	60
	Belgium	. .	85	. .	49
	United States	. .	205	. .	23
	Total	. .	314	. .	132
2836.99.90.20	Other cobalt carbonates				
	United States	10 228	282	19 397	504
	Finland	11 144	293	7 878	188
	Other countries	5 831	190	–	–
	Total	27 203	765	27 275	692
2915.23	Cobalt acetates (weight of material, not cobalt content)				
	United States	45 919	517	37 120	405
	Other countries	16	. . .	10	. . .
	Total	45 935	517	37 130	405
8105.10.10.10	Cobalt waste and scrap fit only for remelting and recovery of the metal content (weight of material, not cobalt content)				
	United States	180 025	676	32 517	645
	Germany	2 544	113	4 869	78
	United Kingdom	55 720	257	–	–
	Other countries	52 566	110	497	17
	Total	290 855	1 156	37 883	740
8105.10.10.20	Cobalt powders (cobalt content)				
	Australia	194 467	7 402	250 072	8 393
	Belgium	3 520	142	119 154	4 838
	Japan	38 081	1 872	95 764	4 580
	South Africa	120 814	5 588	84 098	3 770
	United States	44 007	2 374	58 598	3 072
	Other countries	8 856	371	60 003	1 229
	Total	409 745	17 749	667 689	25 882
8105.10.10.30	Unwrought cobalt, not alloyed (cobalt content)				
	Congo	54 400	1 499	25 614	902
	United States	27 560	1 357	9 566	429
	Other countries	23 677	1 138	17 242	731
	Total	105 637	3 994	52 422	2 062

TABLE 2a (cont'd)

Item No.		1999		2000^{p}	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
8105.10.90	Unwrought cobalt, alloyed, mattes and other intermediate products of cobalt metallurgy (cobalt content of unwrought and mattes; weight of material for intermediates and alloys)				
	United States	9 820	408	7 296	355
	Switzerland	–	–	3	. . .
	Russia	–	–	–	–
	Total	9 820	408	7 299	355
8105.90.00.10	Cobalt bars and rods, not alloyed (cobalt content)				
	United States	2 479	204	2 218	171
	Other countries	2	. . .	150	10
	Total	2 481	204	2 368	181
8105.90.00.90	Cobalt and articles thereof, n.e.s. (cobalt content)				
	United States	41 468	5 140	53 453	6 398
	Other countries	2 048	141	4 021	281
	Total	43 516	5 281	57 474	6 679
	Total imports	1 194 385	37 864	1 580 667	50 040
	Net exports	5 346 588	257 420	3 654 971	184 061

USE[4]	**1998**	**1999**	**2000^{p}**
		(kilograms)	
Cobalt contained in:			
Cobalt metal and metallic compounds	48 381	49 340	46 698
Cobalt pigments, feed and ground coat frit	6 901	8 378	8 487
Cobalt salts and driers and other uses[5]	90 701	72 270	71 780
Total	145 983	129 988	126 965

Sources: Natural Resources Canada.

– Nil; . . Not available or not applicable; . . . Amount to small to be expressed; n.e.s. Not elsewhere specified; ^{p} Preliminary; ^{r} Revised.

[1] Production includes recoverable cobalt in concentrates shipped. [2] Nickel and cobalt are in the mixture, which is an artificial nickel-cobalt sulphide made from nickel-cobalt oxides mined in Cuba. [3] Nickel cobalt sulphides as reported by the International Nickel Study Group (imported into Canada under classification HS 2620.90 Ash and Residue). This material shown in Table 1a includes both the weight and vlaue of imported nickel and cobalt from Cuba and is not included in this table. [4] Available data as reported by consumers. [5] Other uses include glass and chemicals.

Notes: Numbers may not add to totals due to rounding. The absence of a tonnage and value for the cobalt being imported from Cuba (total value shown in nickel Table 1a, entry 2620.90) in the mixed nickel-cobalt sulphides from Cuba means that the total imports shown are less than the actual imports.

TABLE 2b. CANADA, COBALT PRODUCTION, TRADE AND USE, 1975 AND 1980-2000

		Exports			Imports	
	Production[1]	Cobalt Metal	Cobalt Oxides and Hydroxides	Cobalt Ores and Concentrates[2]	Cobalt Oxides and Hydroxides[3]	Use[4]
			(tonnes)			
1975	1 354	431	561	. .	. .	123
1980	2 118	325	1 091	2	26	105
1981	2 080	677	601	24	20	101
1982	1 274	585	212	2	30	81
1983	1 410	885	192	45	30	101
1984	2 123	1 487	373	14	27	113
1985	2 067	1 551	268	36	192	101
1986	2 297	1 805	374	20	31	96
1987	2 490	1 875	440	45	38	120
1988	2 398	3 062	953	98	37	159
1989	2 344	3 262	371	22	33	147
1990	2 184	3 039	391	–	73	194
1991	2 171	3 456	459	–	42	166
1992	2 223	2 963	489	–	64	205
1993	2 150	3 581	394	–	52	187
1994	1 846	3 922	204	–	81	193
1995	2 016	4 227	–	–	41	148
1996	2 150	4 488^r	632	–	33	147
1997	2 168	5 829	526	–	39	136
1998	2 262	6 592	457	–	45	146
1999	2 014	6 307	224	10	114	130
2000^p	2 013	4 901	335	–	103	127

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; ^{p} Preliminary; ^{r} Revised.

[1] Production includes recoverable cobalt in concentrates shipped. Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting.

[2] Cobalt content. From 1975 to 1988, cobalt recovered in Canada from domestic concentrate plus exports of payable cobalt in concentrate plus exports of matte. Starting in 1989 to date, recoverable cobalt in concentrates shipped.

[3] Gross weight. Producers' domestic shipments of refined cobalt plus imports of refined shapes. [4] Use of cobalt in metal, oxides and salts; available data as reported by user.

TABLE 3. CANADA, NICKEL PROCESSING CAPACITY, 2000

	Inco Limited		Falconbridge Limited	Sherritt International Corporation	Canmine Resources Corporation[1]
	Sudbury	Thompson	Sudbury	Fort Saskatchewan	Cobalt
			(t/y of contained nickel)		
Smelter	100 000	63 000	70 000	n.a.	n.a.
Refinery	59 000	55 000	n.a.	30 000	n.a.

Source: Natural Resources Canada.
n.a. Not applicable.

[1] Plant being rehabilitated; initial production to be cobalt in salts with minor nickel by-product production. Plans call for subsequent increase in throughput of cobalt and nickel.

TABLE 4. WORLD MINE PRODUCTION OF NICKEL,[1] 1996-2000

	1996	1997	1998	1999	2000
			(000 tonnes)		
Russia	232	235	235	235	235
Canada	193	191	208	186	191
Australia	113	123	144	124	166
New Caledonia	125	137	125	110	128
Indonesia	88	71	74	89	98
Cuba	54	62	68	67	71
Colombia	28	31	29	39	59
China	44	47	48	50	51
Brazil	21	21	33	33	36
South Africa	34	35	36	36	37
Other (13 countries)	121	121	117	88	113
Total	1 051	1 073	1 117	1 058	1 183

Sources: Natural Resources Canada (NRCan), for Canada; *World Nickel Statistics*, International Nickel Study Group (INSG), October 2001.

[1] Nickel content of sulphide concentrates or nickel content of lateritic ore mined.

Notes: NRCan data used for 1999 for Canada and for total. Numbers may not add to totals due to rounding. Australian data include PAL production since 1999 as estimated by the INSG. Dominican Republic production is the nickel content of ferro-nickel produced.

TABLE 5. WORLD PRODUCTION OF PRIMARY NICKEL, 1996-2000

	1996	1997	1998	1999	2000
			(000 tonnes)		
Russia	190	230	227	228	221
Japan	131	128	127	134	161
Canada	130	132	147	124	134
Australia	74	74	80	79	111
Norway	62	63	70	74	59
China	44	40	40	45	51
New Caledonia	42	44	45	45	44
Cuba	27	34	39	39	40
United Kingdom	39	36	39	38	38
South Africa	34	35	36	36	37
Dominican Republic	30	33	25	25	28
Other (13 countries)	151	164	161	157	160
Total	953	1 012	1 035	1 024	1 083

Sources: Natural Resources Canada, for Canada; *World Nickel Statistics*, International Nickel Study Group, October 2001.

TABLE 6. WORLD USE[1] OF PRIMARY NICKEL, 1996-2000

Country	1996	1997	1998	1999	2000
			(000 tonnes)		
Japan	190	202	169	183	200
United States	153	156	150	152	150
Germany	75	91	97	101	107
Taiwan	50	68	70	89	90
South Korea	50	66	68	81	78
China	42	43	42	47	62
Italy	44	50	53	55	53
France	46	50	55	52	50
Other (more than 27 countries)	292	291	305	322	481
Total	943	1 016	1 009	1 082	1 270

Source: *World Nickel Statistics*, International Nickel Study Group, October 2001.

[1] The term "use" replaces "consumption" and reflects the fact that nickel is not being "used up" in its applications; over 500 000 t of nickel are recycled annually in addition to the material shown above.

TABLE 7. AVERAGE ANNUAL NICKEL PRICES, 1981-2000

	Settlement Price	
	(US$/t)	(converted to US$/lb)
1981	5 985	2.71
1982	4 808	2.18
1983	4 695	2.13
1984	4 783	2.17
1985	4 987	2.26
1986	3 887	1.76
1987	4 849	2.20
1988	14 206	6.44
1989	11 955	5.42
1990	8 880	4.03
1991	8 158	3.70
1992	7 000	3.18
1993	5 283	2.40
1994	6 344	2.88
1995	8 237	3.74
1996	7 500	3.40
1997	6 916	3.14
1998	4 617	2.09
1999	6 015	2.73
2000	8 641	3.92

Source: International Nickel Study Group, *World Nickel Statistics*, October 2001.

TABLE 8. AVERAGE MONTHLY NICKEL PRICES, 1997-2000

	1997	1998	1999	2000
		(US$/t)		
January	7 047	5 495	4 272	8 314
February	7 737	5 390	4 630	9 658
March	7 899	5 399	5 015	10 284
April	7 318	5 397	5 106	9 731
May	7 485	5 023	5 403	10 134
June	7 065	4 479	5 198	8 415
July	6 838	4 329	5 704	8 168
August	6 763	4 084	6 452	8 010
September	6 507	4 106	7 031	8 642
October	6 383	3 875	7 325	7 683
November	6 142	4 135	7 953	7 344
December	5 949	3 881	8 087	7 319
		(converted to US$/lb)		
January	3.20	2.49	1.94	3.77
February	3.51	2.44	2.10	4.38
March	3.58	2.45	2.27	4.66
April	3.32	2.45	2.32	4.41
May	3.40	2.28	2.45	4.60
June	3.20	2.03	2.36	3.82
July	3.10	1.96	2.59	3.70
August	3.07	1.85	2.93	3.63
September	2.95	1.86	3.19	3.92
October	2.90	1.76	3.32	3.48
November	2.79	1.88	3.61	3.33
December	2.70	1.76	3.67	3.32

Source: International Nickel Study Group, various issues of *World Nickel Statistics*.

TABLE 9. REFINED COBALT[1] AVAILABILITY, 1996-2000

Company	1996	1997	1998	1999	2000
			(tonnes)		
PRODUCTION OF COMPANIES BELONGING TO THE COBALT DEVELOPMENT INSTITUTE					
Falconbridge	3 099	3 417	3 851	4 009	3 433
Gécamines	3 540	2 808	4 490	5 180[b]	4 320
ICCI	2 070	2 250	2 640	2 770	2 855
Inco	1 544	1 500	1 740	1 420	1 470
OMG	4 160	5 000	5 250	6 200	7 700
QNI	–	617	1 395	1 539	1 520
Sumitomo	228	263	329	221	311
Zambia[2]	4 799	3 949	5 011	3 946	2 316[c]
CTT	80	220	241	470	1 200
Eramet	174	159	172	180	204
Union Minière	1 200	1 200	1 200	950	1 110
Murrin Murrin	–	–	–	83	925
Kasese	–	–	–	77	420
Subtotal	20 894	21 383	26 319	27 045	27 785
PRODUCTION OF OTHERS					
South Africa	292	294	320	320[e]	320
Brazil	193	266	364	630	792
India	–	110[e]	120[e]	120[e]	206
China	1 200	1 200	1 200	1 200	1 200
Mopani Copper	–	–	–		1 026
Bulong	–	–	–	79	192
Subtotal	1 685	1 870	2 004	2 349	3 736
EXPORTS AND SALES FROM STOCKPILES					
DLA sales	2 052	1 621	2 310	1 679	3 083
Sales from other stocks	500	–	–	–	–
C.I.S. exports	1 654	3 200	2 800	2 678	4 700[d]
Subtotal	4 206	4 821	5 110	4 357	7 783
Total availability[3]	26 785	28 074	33 433	33 751	39 303

Source: *Cobalt News*, April 2001, The Cobalt Development Institute.

ICCI = International Cobalt Corporation Ltd. (marketed by Sherritt International Corporation)
OMG = OM Group
ZCCM = Zambia Consolidated Copper Mines
CTT = La Compagnie de Tifnout Tiranimine
RAMZ = Roan Antelope Mining Corporation
DLA = Defense Logistics Agency
Gécamines = La Générale des Carrières et des Mines

– Nil; [e] Estimated.

[a] Excludes the Central Mining Group production. [b] Includes correction for CTT. [c] Chambishi Metals production only. [d] Figure under investigation; 3200 t is believed by some to be more accurate.

[1] "Refined cobalt" means all cobalt units whether in metal or chemicals derived from feed requiring further refining. The following materials are not counted as feed: DLA or other stockpile releases, Russian output, Lisaki output, and lower grade Moroccan output. [2] Zambian production includes ZCCM, RAMZ and Avmin. [3] Numbers may not add to totals due to rounding.

Potash

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The term "potash," derived from the Dutch word *potasch*, originally referred to wood ash from which was extracted potassium carbonate, a basic chemical of pre-modern times. Today it applies to a suite of potassium-bearing minerals and derived chemicals: sylvite (potassium chloride, KCl or muriate of potash [MOP]); carnallite (potassium-magnesium carbonate); langbeinite (potassium-magnesium sulphate); potassium sulphate, and potassium nitrate. The dominant product is KCl.

Fertilizer use consumes over 90% of output. Potash promotes plant growth and enhances absorption of nitrogen and phosphate nutrients. Other uses are in chemicals, de-icing salt, water conditioners, detergents, ceramics and pharmaceuticals. Canada is the leading producer and exporter of potash.

CANADIAN INDUSTRY

The Canadian potash industry began in the early 1960s with the opening of the first mines in Saskatchewan. By the mid-1980s, two new mines were opened in New Brunswick, one of which was closed because of flooding in 1997. In 2000, nine underground mines and two solution mines were operated by three companies employing over 3400 workers. Ten of the operations are in Saskatchewan and one underground mine is in New Brunswick.

Production increased 13.3% over the previous year to an estimated 9.4 Mt K_2O[1] (15.3 Mt KCl) and capacity utilization rose accordingly to 68% from 61%. Shipments in 2000 were up 10% to 9.1 Mt K_2O worth $1.7 billion (f.o.b. mines). Exports accounted for over 95% of shipments, making Canada the world's largest exporter with 43% of world trade in potash. Canada ships to some 40 countries but the United States purchased 58% of the total and, together with China (13%) and Brazil (8%), these three major markets took almost 80% of Canadian export sales.

Saskatchewan

Saskatchewan produced about 95% of Canadian potash output in 2000. The province accounts for 33% of world production and capacity, and its operations rank as the world's most productive. Temporary shut-downs scheduled for inventory control were few during the year as producers reported record shipments.

Potash Corporation of Saskatchewan Inc. (PCS Inc.), based in Saskatoon, is the largest publicly held potash producer in the world, owning 22% of global capacity. PCS Inc. operates five mines in Saskatchewan: Cory Division (Saskatoon), Allan Division, Lanigan Division, Rocanville Division, and Patience Lake Division, a solution mine. The company also owns 25% of reserves at Esterhazy that are mined by IMC Esterhazy Canada Limited Partnership (formerly known as International Minerals & Chemical Corporation [Canada] Global Limited). In 1999, PCS Inc. acquired a potassium nitrate operation in Chile with a capacity of 360 000 t/y KNO_3. PCS Inc. set a new production record in 2000 of 7.15 Mt KCl, up 13.5% from that of 1999. Similarly, sales topped 6.9 Mt. A milling capacity of 13.4 Mt KCl supports the flexibility needed to meet surges in demand.

IMC Potash Colonsay Inc., IMC Esterhazy Canada Limited Partnership, and IMC Potash Belle Plaine, all divisions of IMC Global Inc., manage four mines in Saskatchewan: one at Viscount/Colonsay, the interconnected K1 and K2 mines at Esterhazy, and the large solution mine at Belle-Plaine. IMC Potash's capacity is estimated at 7 Mt/y KCl, 32% of the Canadian total, and production was an estimated 6.5 Mt KCl in 2000. The water inflow problem that began in 1985 at K1/K2 is being managed and production was not affected in 2000. An expansion of the Belle Plaine operations remains in the company's plans, although it will be extended beyond the original 2004 target date.

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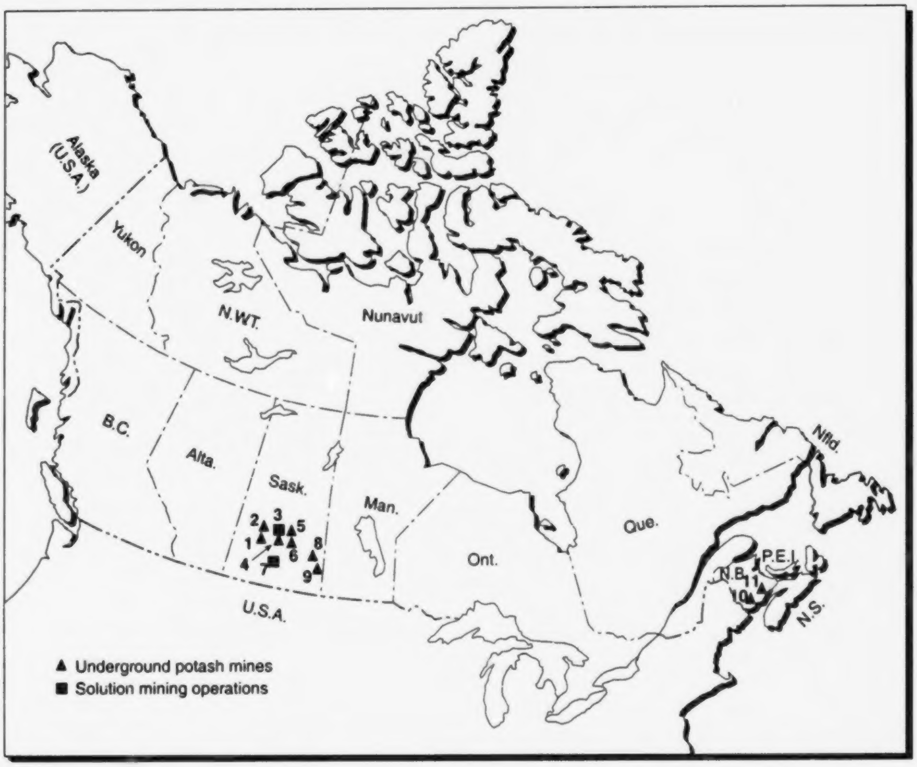
[1] Unless noted otherwise, statistical data refer to potassium oxide (1 t KCl [product] = 0.6 t K_2O).

Figure 1
Location of Potash Mines and Operations in Canada, 2000



Numbers refer to locations on map above.

Underground Potash Mines

1. Agrium Inc., Vanscoy, Saskatchewan
2. Potash Corporation of Saskatchewan Inc., Cory Division, Saskatoon, Saskatchewan
4. Potash Corporation of Saskatchewan Inc., Allan Division, Allan, Saskatchewan
5. IMC Potash Colonsay Inc., Colonsay, Saskatchewan (formerly known as IMC Central Canada Potash Inc.)
6. Potash Corporation of Saskatchewan Inc., Lanigan Division, Lanigan, Saskatchewan
8. IMC Esterhazy Canada Limited Partnership (K1 and K2 mines), Esterhazy, Saskatchewan (formerly known as International Minerals & Chemical Corporation [Canada] Global Limited)
9. Potash Corporation of Saskatchewan Inc., Rocanville Division, Rocanville, Saskatchewan
10. PCS Cassidy Lake Limited, Clover Hill, New Brunswick (milling facilities only) (formerly known as Potash Corporation of Saskatchewan Inc., Cassidy Lake Division)
11. Potash Corporation of Saskatchewan Inc., New Brunswick Division, Sussex, New Brunswick

Solution Mining Operations

3. Potash Corporation of Saskatchewan Inc., Patience Lake Division, Patience Lake, Saskatchewan
7. IMC Potash Belle Plaine, Belle-Plaine, Saskatchewan (formerly known as IMC Kalium Canada Ltd.)

Agrium Inc. operates a mine at Vanscoy with an estimated capacity of 1.8 Mt/y KCl. Production in 2000 was approximately 1.6 Mt.

Big Quill Resources Inc. manufactures potassium sulphate from purchased potash (KCl) and sodium sulphate produced by evaporation of natural brines from Big Quill Lake. A 40 000-t/y unit using the glaserite process was commissioned in 1999 to increase capacity and a further expansion to 300 000 t/y is planned for the future. Potassium sulphate is used as a fertilizer for crops that are sensitive to chloride. It also has chemical and other uses.

New Brunswick

PCS Inc.'s New Brunswick Division operated the province's only working potash mine about 5 km east of Sussex. A second mine, then owned by Potacan Mining Company, located 20 km southeast of Sussex, was closed by flooding in 1997. The Potacan mill, now PCS Cassidy Lake Limited (a division of PCS Inc.), is used to upgrade standard potash from Rocanville, Saskatchewan. Potash from Sussex is hauled 60 and 80 km to the Barrack Point potash terminal in Saint John.

Manitoba

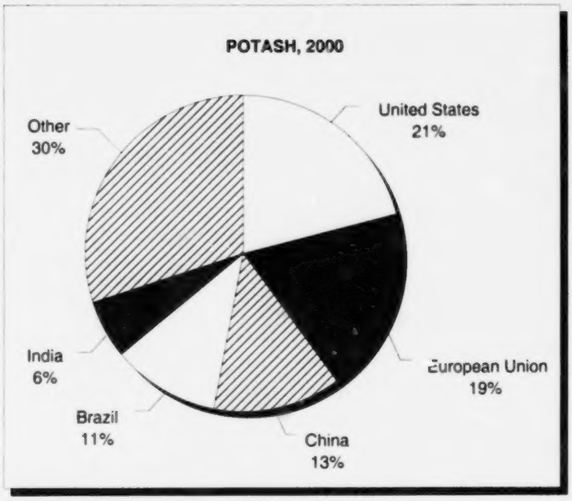
A joint venture between Entreprise minière et chimique of France and the Government of Manitoba, incorporated as the Manitoba Potash Corporation, holds the rights to a sylvinite deposit in the Russell-Binscarth area adjacent to the Saskatchewan border. No decision to go ahead has yet been taken. Proven reserves were estimated at 120 Mt grading 24.5% K_2O.

WORLD OVERVIEW

Global potash production (all forms) rose 1.6% in 2000 to 27.7 Mt K_2O and sales increased 2.5% to 27.1 Mt, despite a 2% decrease in world grain production. Most of the increase in potash sales is attributable to a strong upswing in Brazilian and U.S. demand. All regions but the C.I.S. recorded increased sales. Seventy-six percent of world output in 2000 was produced by four countries: Canada accounted for 35.5%; Russia, 14.5%; Belarus, 13%; and Germany, 13%. The remainder, in order of volume, was produced by Israel (6.8%), Jordan (4.5%), the United States, the United Kingdom, Spain, Brazil, Chile, France and China.

Capacity utilization, particularly in Canada, serves to balance supply and demand. During soft markets, the industry reduces output through planned periods of mine shut-downs and production can be raised quickly to meet increased demand. World producers operated at an estimated 71% of capacity, up 1% from 1999. Canadian capacity utilization increased from 61% to 68%, whereas C.I.S. capacity declined 5% to 58%. The rest of the world together operated at an estimated 90% of capacity.

Figure 2
Percentage of Fertilizer Potash Used by Country, 2000



Source: Natural Resources Canada.

Total trade was up 3.3% to 20.4 Mt, largely due to a 22.4% increase in imports by Brazil, the world's third largest user, and a 7% increase by the United States. Foreign deliveries to socialist Asia were up 1.5% with increased sales to Vietnam offsetting a 1% decline for China. Non-socialist Asia registered a decline in imports of 1%, reflecting a 10% reduction in purchases by India where drought reduced fertilizer application during the Kharif (summer) season. Western Europe and the Middle East also registered decreased imports.

Americas

Production in Brazil from Companhia Vale do Rio Doce's potash mine in Sergipe State has increased almost 50% in the past five years to reach 567 000 t in 2000. A further capacity expansion to 840 000 t/y is scheduled for late 2001.

Chile's potash production increased 5.8% in 2000 following a 13% jump in 1999. SQM Salar S.A., a subsidiary of Sociedad Quimica y Minera de Chile S.A., produced potash products and other chemicals from alkaline brines at Salar de Atacama. Continuing its multi-year expansion plans, a new project with joint-venture partner Norsk Hydro added 160 000 t of annual potassium nitrate capacity. The company also boosted KCl production by 5.8% to 550 000 t in 2000.

PCS Yumbes, formerly Minera Yolanda S.A., a nitrates producer also in the Salarde Atacama region, was purchased by PCS Inc. in 1999. That company imports potash from Canpotex Limited and purchases some from SQM for use in the conversion of sodium nitrates to potassium nitrate. Plant capacity is 265 000 t/y of KNO_3 plus other products, including iodine.

In the United States, potash production declined 9.5% because of an interruption in operations for the installation of new mining and processing equipment at both IMC Global Inc.'s and Mississippi Potash Inc.'s underground operations in Carlsbad, New Mexico. IMC Global Inc. had its first full year of operation of a new 325 000-t/y potassium-magnesium chloride plant at Carlsbad. The company also produces KCl and potassium sulphate at its Carlsbad facilities and operates a 145 000-t/y solution mine near Hershey, Michigan. The estimated output of all products combined from U.S. operations was about 2 Mt in 2000, half of which was KCl. Mississippi Potash's output from its Carlsbad mines was reported at 1.0 Mt (1.1 million short tons).

Commonwealth of Independent States

Russia's two potash operations, Uralkali JSC at Berezniki and Sylvinit Ltd. at Solikamsk, together produced 6.2 Mt KCl (3.716 Mt K_2O equivalent) in 2000, down 8.2% from 1999 and representing 58% capacity utilization. Domestic and export sales were both down. Canpotex, the Canadian offshore marketers of Canadian potash, signed a joint marketing agreement with Uralkali to handle this company's products in markets outside North America and Europe. Finalization of the agreement was announced on January 5, 2001.

Production in Belarus declined 6.7% in 2000 to 5.6 Mt KCl, and deliveries, both domestic and export, were down. PO Belaruskali, the producing company, has initiated a $120 million-$140 million annual investment program over 10 years to modernize and upgrade its production and shipping facilities. The European Union levied anti-dumping duties on potash from the C.I.S. in May and these remained in force into 2001.

Europe

Despite the planned phase-out of production from the two remaining operations in Alsace by 2002 (Marie-Louise Ouest) and 2004 (Amélie) and a seven-year consecutive decline in output to 1999, production in France increased 3.2% in 2000. In Germany, Kali und Salz GmbH (K&S) celebrated the 100th anniversary of potash mining in the Werra-Ulster region. K&S produces the whole range of potash products and is the world's largest producer of potassium sulphate. An estimated Euro 90 million investment during 2000 is an extension of K&S's development plans over the past few years to rationalize production units and expand the production of potash and magnesium products. A fire at the Unterbreizbach mine may have contributed to a reduction in output of 3.8% to 3.4 Mt K_2O in 2000, although sales were down only 1.6%. IBERPOTASH S.A., a joint-venture company owned by Dead Sea Works Ltd. (DSW) of Israel and Spanish interests, produced 522 000 t K_2O in 2000 from mines at Llobregat and Suria in Catalonia, Spain. This was a decrease of 4.9% from 1999. In the United Kingdom, Cleveland Potash Ltd.'s output rose 21.4% in 2000 to 600 000 t, a recovery to former levels after the flooding of a conveyor haulage way in 1999.

Middle East

In Israel, DSW's production rose 2.7% in 2000 to 2.9 Mt KCl, continuing a series of increments over the past four years as a result of investment in expanded capacity, the debottlenecking of mill facilities, the removal of salt "mushrooms" from the carnallite evaporation ponds, and increased salinity of the Dead Sea due to extended drought conditions. Haifa Chemicals Ltd. operates a 200 000-t/y KNO_3 plant near Mishor Rotem.

In Jordan, the Arab Potash Co. Ltd. (APC) increased output in 2000 by 7.5% to 1.9 Mt KCl. APC is also in the process of removing salt "mushrooms" from its ponds which, when completed in late 2001, will increase carnallite capacity by over 50 000 t/y. The company is continuing with an aggressive expansion program aimed at increasing potash capacity to 2.5 Mt/y by 2005. Through joint ventures, APC participates in the production of several other potash products (nitrates, NPK products, etc.) that use their primary product.

Asia

China, the world's second largest market for potash after the United States, is itself a small producer. Output in 2000 increased 11.5% over the previous year to 480 000 t KCl. Spur Ventures Inc. of Vancouver, owner of Kunlun Potash Ltd., entered a joint venture with Golmud Potash Corporation to increase capacity at Golmud. Qinghai Yanhu Potash Fertilizer Co. Ltd. has secured a US$57.2 million (475 million yuan) loan from the Industrial and Commercial Bank of China to finance a 300 000-t/y potash project in northwestern China's Qinhai Province. The resource is brine from Qarhan Salt Lake.

In northeastern Thailand, the ASEAN Potash Mining Company Ltd. (APMC) appears to be stalled by the need for sufficient investment capital. The $590 million underground project at Bamnet Narong, with a projected capacity of 1.1 Mt/y KCl, had been slated for engineering design and pilot tests to be completed before the end of 2000. A 933-m decline has been constructed and 100 000-t salt and 120 000-t carnallite ore samples have been extracted and stored. Potash production was originally scheduled to begin in 2004. A second company, Asia Pacific Potash Corporation (APPC), with minority shareholder Norsk Hydro Asia Pte. Ltd., is scheduled to begin construction in 2001 on their Somboon silvinite project in the Sakon Nakhon Basin in northern Thailand near the Laos border. The projected capacity is 2 Mt/y with completion in 2004. Domestic markets are expected to absorb 0.4 Mt and the balance will be sold in Southeast Asian markets. Norsk Hydro will market the entire output. APPC also owns the nearby Udon deposit.

PRICES

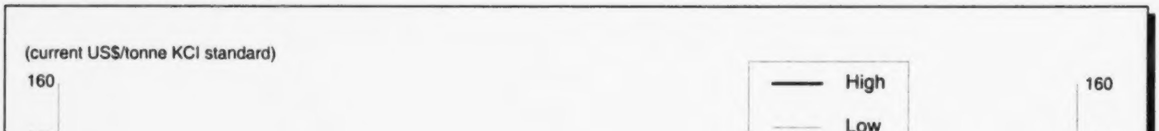
Canpotex Limited, representing all Saskatchewan potash producers for offshore sales, sells f.o.b. Vancouver, c.i.f. foreign ports or out of stockpiles in Asia. Quoted prices were unchanged from 1999 at US$110-$129/t f.o.b. Vancouver for standard grade and US$128-$132/t for granular. One Canadian producer's price list for U.S. customers quoted US$91/short ton (st) f.o.b. mines for standard grade and $96 for granular for deliveries from June 1 to September 10, and US$97 and $102 respectively from September 11th forward. Midwest U.S. warehouse sales for the same producer varied from $US118 to $123/st for coarse grade from June to September and from US$124 to $129/st from September forward. The differences reflect freight increments. Average realized prices for Canadian potash were down 4% from 1999 because of competitive pressures and higher freight rates.

Price movements for C.I.S. potash through Baltic ports parallel those of Vancouver but at some $20/t cheaper. Quotes for standard and granular for the year were steady at US$91-$106/t and US$94-$111 f.o.b. Baltic ports.

OUTLOOK

Following record potash sales in 2000 and after a good 1999 sales year, customer inventories are high. Accordingly, fourth-quarter sales declined from the previous quarters and some major producers report further steep declines in the first quarter of 2001. PCS Inc. announced a 34% decline in sales volume in the January-March 2001 period and a shut-down of 15 more weeks' duration than in the first quarter of 2000. PCS Inc. has a six-week shut-down planned for the second quarter as well. IMC Potash reported an 18% drop in sales volume during the first quarter of 2001. Moreover, despite record sales in 2000, Canadian producer inventories had increased by 16.4% to 1.77 Mt by year-end, largely attributable to the fourth-quarter slowdown in sales.

Figure 3
Canada, Offshore Potash Price Quotations, 1981-2000
f.o.b. Vancouver Contract



Source: Compiled by Natural Resources Canada from trade magazines and specialized subscriptions.

In addition to the effect of high customer potash inventories, the burgeoning costs for nitrogen fertilizers, which are manufactured using high-cost natural gas, and a four-year slide in grain prices limited farmers' ability to spend. Low prices for palm oil, a commodity that requires high potash applications, has resulted in a sharp reduction in sales to Malaysia and Indonesia, which together accounted for almost 2 Mt of KCl purchases in 2000. Poor weather conditions in North America have also delayed spring planting in 2001.

Most grain prices appeared to have bottomed out at long last by year-end 2000. As an indicator, U.S. corn prices are up 8% in November 2000 relative to a year earlier and wheat prices are up 2.3%. Nevertheless, they remain over 30% below 1996 prices. Higher grain prices are unlikely to stimulate demand for potash and other fertilizers in the near term at least because U.S. Department of Agriculture global wheat production forecasts for 2001 are down from the previous year and demand is being partially met through stock withdrawals. The production of coarse grains is forecast to be down in the United States but globally is projected to increase. Chinese rice stocks are estimated at 95 Mt, which is almost 25% of world production levels. A continuation of the recovery in grain prices bodes well for potash sales beyond 2001.

The industrial use of potash (non-fertilizer use) is expected to be down from 2000 levels as the world economy slowed in the last quarter of 2000 and remained soft in the first quarter of 2001. Non-fertilizer use amounts to about 10% of total potash use.

Natural Resources Canada estimates that world potash deliveries will decline 7% to 23.5 Mt (K_2O equivalent) in 2001 from the previous year. Rising grain prices and a rundown in customer stocks should give potash markets a boost for 2002. In the longer term, population growth, optimization of the soil nutrient balance in Asia (an ideal nitrogen-to-potash ratio of 1:0.30), and increasing protein levels in diets in the developing world should drive a potash demand growth that will average 2% per year. Most of this growth is expected to arise from agricultural upgrading and expansion in developing countries.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of April 30, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
3104.20	Potassium chloride	Free	Free	Free	Free
3104.30	Potassium sulphate	Free	Free	Free	Free
3104.90.00.10	Magnesium-potassium sulphate	Free	Free	Free	Free
3104.90.00.90	Other	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADIAN POTASH PRODUCED, SHIPPED AND TRADED, 1999 AND 2000

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION, Potassium Chloride					
	Gross weight	13 564 212	. .	15 290 300	. .
	K_2O equivalent	8 304 421	. .	9 408 953	. .
SHIPMENTS					
	K_2O equivalent	8 475 270	1 634 041	9 106 817	1 714 453
IMPORTS, Fertilizer Potash[1]					
3104.20	Potassium chloride				
	United States	3 791	527	5 882	875
	France	333	48	474	63
	Czech Republic	–	–	98	13
	Germany	35	4	57	9
	United Kingdom	9	2	36	4
	Norway	1	. . .	10	2
	Switzerland	3	. . .	1	. . .
	Spain	17	1	–	–
	Canada	67	8	–	–
	Total	4 256	590	6 558	966
3104.30	Potassium sulphate				
	United States	374	219	310	136
	Belgium	209	121	169	86
	Finland	–	–	53	41
	Japan	5	6	6	7
	United Kingdom	4	5	1	1
	Germany	1	1	1	1
	Total	593	352	540	272
3104.90.00.10	Magnesium-potassium sulphate				
	United States	64 135	11 146	52 071	8 980
	Canada	–	–	16	3
	Total	64 135	11 146	52 087	8 983
3104.90.00.90	Other potassic fertilizer				
	United States	9 683	3 394	45 445	9 158
	Norway	80	45	800	445
	Chile	112	68	98	61
	Israel	767	290	87	54
	New Zealand	43	29	40	27
	United Kingdom	192	81	51	27
	Netherlands	9	6	6	2
	Italy	–	–	1	. . .
	Mexico	19	15	–	–
	Total	10 905	3 928	46 528	9 774
	Potash Chemicals				
2815.20	Potassium hydroxide (caustic potash)	19 554	11 487	16 825	9 990
2834.21	Potassium nitrate	9 049	5 203	8 682	4 758
2835.24	Potassium phosphates	1 846	2 148	2 103	2 480
2836.40	Potassium carbonates	2 718	1 801	3 626	2 387
2839.20	Potassium silicates	886	533	1 123	521
	Total potash chemicals	34 053	21 172	32 359	20 136
EXPORTS, Fertilizer Potash[1]					
3104.20	Potassium chloride				
	United States	8 459 616	1 123 359	8 779 766	1 117 055
	China	1 747 555	296 200	1 943 241	413 891
	Brazil	870 390	129 114	1 188 671	212 460
	Japan	442 789	84 228	492 357	105 949
	Malaysia	442 456	74 672	465 302	99 732
	South Korea	416 165	70 307	419 555	90 514
	India	240 459	41 029	244 000	52 633
	Australia	273 958	46 656	191 262	41 028
	Indonesia	166 552	28 279	176 388	37 522
	Taiwan	159 495	26 676	163 985	35 211
	New Zealand	147 453	24 893	150 406	32 340
	Thailand	151 786	25 919	137 883	29 626

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
	Vietnam	71 772	12 013	100 820	21 550
	Belgium	117 610	18 807	90 312	19 420
	Spain	81 433	11 155	83 637	14 853
	Chile	54 392	9 071	62 044	13 329
	Colombia	21 383	3 652	61 495	13 235
	Italy	78 659	13 429	61 031	13 231
	Costa Rica	37 390	6 248	52 031	10 048
	Philippines	59 345	9 939	43 195	9 331
	Guatemala	59 677	10 029	47 387	8 500
	Singapore	15 101	2 572	23 053	5 013
	Cuba	70 500	8 638	36 000	4 377
	Mexico	11 570	1 965	20 100	3 275
	Salvador	–	–	13 200	2 794
	South Africa	10 298	1 750	10 000	2 143
	Honduras	–	–	16 450	2 117
	Ecuador	–	–	8 000	1 754
	Venezuela	–	–	7 700	1 722
	Dominican Republic	12 041	1 637	12 200	1 601
	Fiji	4 932	838	5 000	1 065
	Argentina	4 409	757	2 974	639
	Pakistan	108	70	36	8
	France	44 864	5 449	18	4
	United Kingdom	108	35	18	4
	Denmark	32 263	3 935	–	–
	Portugal	6 550	792	–	–
	Ivory Coast	9 900	1 339	–	–
	Total	14 322 979	2 095 452	15 109 517	2 417 974
3104.30	Potassium sulphate				
	United States	21 760	9 297	17 859	7 409
	Romania	21	12	–	–
	Total	21 781	9 309	17 859	7 409

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; p Preliminary.
[1] Countries are ranked in descending order of value for 2000.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADIAN POTASH, CURRENT SITUATION, 1991-2000, AND FORECAST, 2001

	Actual										Forecast[1]
	1991	1992	1993	1994	1995	1996	1997	1998	1999[r]	2000[p]	2001•
	(000 tonnes K_2O)										
Capacity	12 045	12 180	12 180	12 235	13 220	13 310	13 390	13 400	13 405	13 460	13 460
Production	7 402	7 270	6 850	8 182	9 065	8 042	9 030	9 190	8 230	9 409	8 230
Capacity utilization (%)	61	60	56	67	69	60	67	69	61	68	61
Sales	7 056	7 025	6 863	8 517	8 635	7 970	9 510	8 265	8 290	9 106	8 290
of which: Domestic	350	370	356	385	345	355	490	450	425	455	425
United States	3 610	3 945	4 048	4 560	4 495	4 335	5 295	4 325	4 245	4 570	4 250
Offshore	3 096	2 710	2 459	3 535	3 795	3 280	3 725	3 490	3 620	4 080	3 615
Year-end stocks	1 585	1 785	1 726	1 285	1 545	1 420	935	1 520	1 380	1 767	1 700
World production	26 035	24 036	20 407	22 687	24 302	23 331	25 467	25 870	25 775	25 814	25 000
World capacity[2,r]	37 068	36 594	35 512	35 624	36 299	36 529	36 836	36 490	36 663	36 840	36 840
World sales (IFA)	24 175	23 175	20 835	23 620	23 375	22 490	25 745	24 260	24 630	25 260	24 500
Canada/world											
Production ratio (%)	28.4	30.2	33.6	36.1	37.3	34.5	35.5	35.5	31.9	35.5	33.0
Capacity ratio (%)	32.5	33.3	34.3	34.3	36.4	36.4	36.4	36.7	36.6	36.5	36.5

Sources: Natural Resources Canada; Potash and Phosphate Institute.
• Estimated; [p] Preliminary; [r] Revised.
[1] Forecast by Natural Resources Canada. [2] Estimated by Natural Resources Canada.

TABLE 3. WORLD POTASH PRODUCTION, 1994-2000

	1994	1995	1996	1997	1998	1999[r]	2000•
	(000 tonnes K_2O)						
Brazil	242	223	234	280	327	337	340
Canada	8 182	9 065	8 044	9 029	9 195	8 230	9 174
Chile	52	52	179	235	280	312	330
China	90	171	150	186	168	260	290
C.I.S.[1]	5 112	5 605	5 395	6 650	6 912	7 665	7 098
France	870	802	751	665	417	311	321
Germany	3 286	3 278	3 334	3 423	3 582	3 545	3 409
Israel	1 259	1 326	1 500	1 488	1 668	1 702	1 748
Jordan	930	1 068	1 059	849	916	1 080	1 162
Spain	684	650	680	640	497	549	522
United Kingdom	580	582	618	565	608	495	601
United States	1 400	1 480	1 387	1 465	1 300	1 400•	1 350•
Total	22 687	24 302	23 331	25 475	25 870	25 886	26 345

Sources: Natural Resources Canada; International Fertilizer Association; company interviews.
• Estimated; [r] Revised.
[1] Russia and Belarus.

Silica

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SUMMARY

In Canada, preliminary available data, as reported by consumers for 1999, show that silica use was 2.7 Mt, a slight decline of 27 088 t from the previous year. Production, as reported by companies and compiled to date for 2000, was valued at $40.8 million, a minor decline of 4.2% from 1999's total of $41.3 million. Imports were valued at almost $102.9 million for 2000, an 8.3% increase from the 1999 value of $95.0 million. Exports were valued at over $6.9 million for 2000, an increase of 16.9% from $5.9 million in 1999 (Table 1).

The decline in silica use is visible in all major silica-consuming industry sectors (Table 3). The main consuming sectors in 1999, in order of importance, were: primary glass and glass containers, and glass fibre wool (24.4%); nonferrous smelting and refining (18.7%); and foundries (11.3%). The chemicals (2.3%) and abrasives (1.9%) sectors followed, along with the remaining other product sectors combined (41.4%). Sand represents 54.2%, lump, 42.3%, and flour, 3.5% of total silica use (Table 4).

During the last decade, the glass industry experienced a period of rationalization and consolidation with new corporate relationships appearing to adapt to the stiff competition from aluminum, polyethylene terephthalate (PETP) and other plastics, and paper containers, which certainly must have had an impact on production and supply to local markets, especially near the Canada-U.S. border. Similarly, industrial silica sand is one of the fundamental raw materials used by the foundry industry. Foundry sand is very important in applications for silica sand and for metallurgical applications. Silica sand is also used in the metal casting process. Metal castings are used in virtually every industry to produce the majority of molds and cores.

PRICE

The January 2001 edition of *North American Minerals News* reported that silica sand prices (ex-works U.S.A., $/t, f.o.b. plant) were in the range of $12-$25 for foundry sand, dry, bulk, and $14-$26 for glass sand, container. The *Mineral PriceWatch* publication of July 2000 reported that silica sand prices had risen lately due to higher production costs, which resulted in lower tonnages of material being used. *Mineral PriceWatch* also stated that industry sources have suggested that any price increases are unlikely to occur during the second half of 2000.

TRADE

In its 1992 report on *The Economics of Quartz*, Roskill Information Services Ltd. estimated that approximately 10 billion t of silica in various forms are used each year worldwide.

This is a good incentive and opportunity for trade. However, although Canada produced 1.5 Mt of silica in 2000, it is not self-sufficient in silica sand and substantial quantities are imported. Of Canada's total silica imports of 392 743 t for 2000, 90.6% came from the United States, of which 71.1% was silica and quartz sands used in foundries and glass manufacturing.

In 2000, Canada imported 13.1% less silica compounds compared to 1999. Imports fell from 444 171 t to 392 743 t even though their value increased from $95 million to $102.9 million.

Imports from the United States come from loosely consolidated and easily processed sandstones or lake sand deposits located near the Great Lakes. Major U.S. operations are located in the states of Illinois, Wisconsin, Michigan and Indiana.

The Canadian iron and steel foundry industries used about 74.5% of those imports from the United States, with most of it going to the provinces of Ontario, Manitoba and Quebec. The Canadian glass manufacturing industries used about 25.5% of the imports from the United States, with most of it going to Ontario, Quebec and Saskatchewan (Tables 1 and 2).

Canada's exports of silica for 2000 totaled 394 499 t, of which 97% went to the United States with silica sands and quartz sands representing the bulk (93%) of them.

Canada exported 394 499 t of silica in 2000, 22.6% more than the 321 878 t exported in 1999. The value of exports also increased 16.9%, going from $5.9 million in 1999 to $6.9 million in 2000.

TRENDS, 1992-2000

Canada's use of silica since 1992 has increased slightly (Figures 1 and 2), a reflection of the increased economic performance of the United States and Canada, especially in recent years. The decline from 1999 could be a result of cautionary demand, recycling, reclamation, price changes, or a combination of these factors. With the exception of 1994, silica sand has always been the principal raw material used, followed by lump and flour material.

Canadian silica production (shipments) seems to have reached a high in 1994 and a reprieve in 1998, but has maintained a slight decline since then (Figure 3). Production in Alberta has increased progressively since 1994 while production in Quebec since 1995 and in Ontario since 1996 has remained relatively flat.

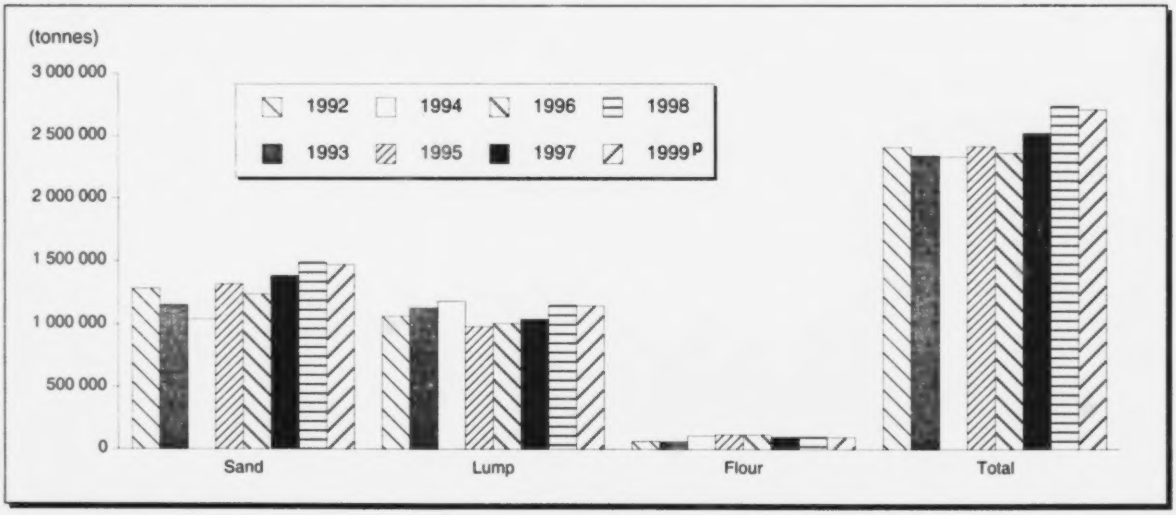
Overall, Canada's value of imports of silica compounds has increased since 1992, and so has the value of exports, although at a slower pace (Figure 4).

PRODUCTION AND MARKET CONSIDERATIONS

Silica (SiO_2) is formed from the two most abundant elements in the earth's crust: silicon and oxygen. Silica is a common mineral, existing in a range of crystalline and non-crystalline forms. Sands, sandstones, quartzites and quartz crystals serve as the basic raw materials for a wide range of applications (Tables 5 and 6), including construction, glass, ceramics, refractories, silicon and ferrosilicon, abrasives, electrical and optical uses. Specialty silica (Table 7) materials are rocks that consist predominantly of silica and are produced as chunks, round pebbles, and sawed or trimmed blocks and other shapes for non-construction applications. The diverse uses of silica and quartz complicate what drives its market. Industrial silica sand has more different uses than any other nonmetallic mineral, mainly due to its common occurrence around the world. Silica sand that is mined and processed for industrial use must conform to the chemical (e.g., purity) and physical specifications set by the customers. Some of the most important physical properties are: grain size and distribution, grain shape (sphericity), grain strength, and refractoriness. Health and safety issues are applied as they relate to crystalline silica (silicosis problems).

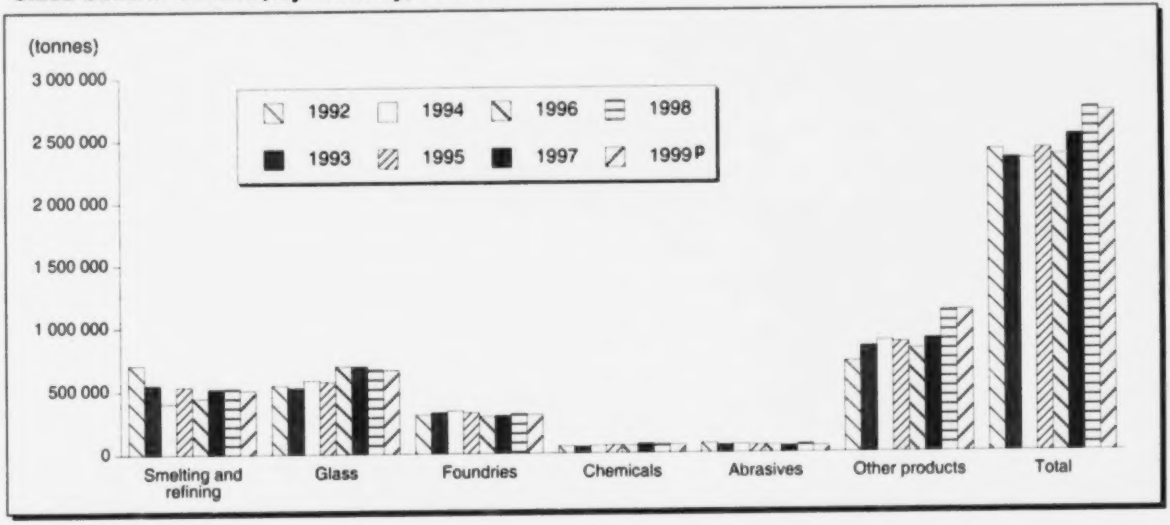
The economics of the production and sale of the many types of silica are governed by many factors, but demand for silica is controlled mostly by the fortunes of the glass and foundry industries. The production of silica is usually a low-price, high-tonnage, very

Figure 1
Silica Used in Canada, by Industry, 1992-99



Source: Natural Resources Canada.
p Preliminary.

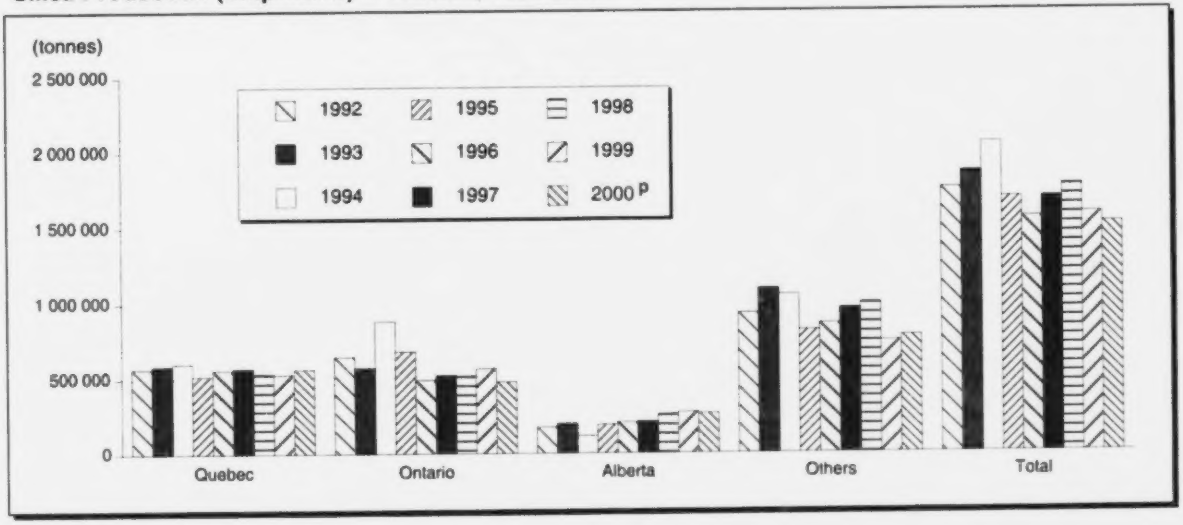
Figure 2
Silica Used in Canada, by Industry, 1992-99



Source: Natural Resources Canada.

p Preliminary.

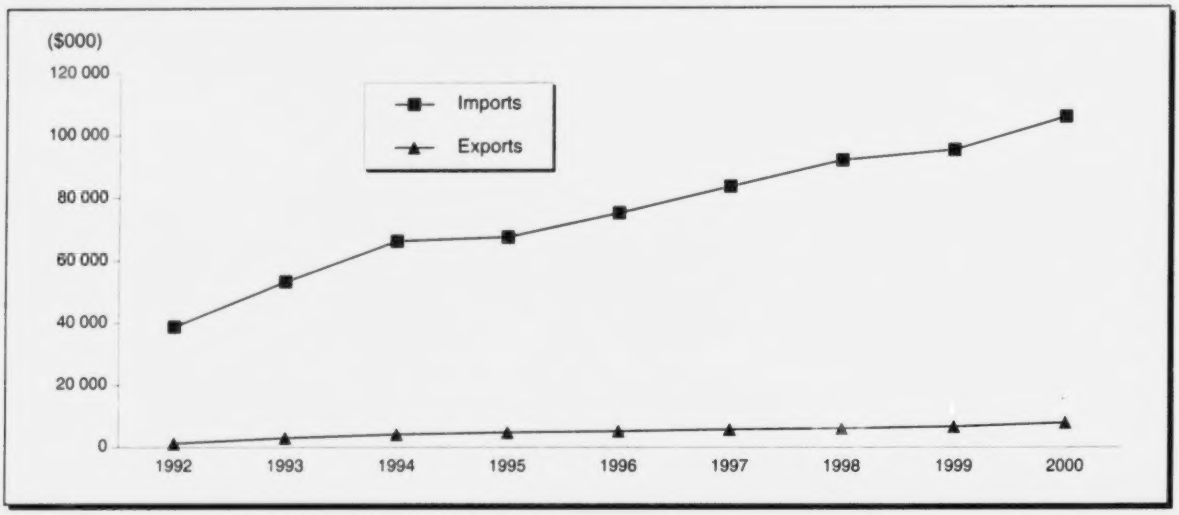
Figure 3
Silica Production (Shipments) in Canada, 1992-2000



Source: Natural Resources Canada.

p Preliminary.

Figure 4
Silica Canadian Trade of Silica and Silica Compounds, 1992-2000



Source: Natural Resources Canada.
P Preliminary.

competitive operation. Successful operation of a particular silica deposit is dependent upon the ability of the operator to supply consumers with suitable grades (Table 8) of silica at competitive prices. Silica may be obtained from river, lake or sea-side sand deposits by dredging; however, it is generally obtained by open-pit operation of inland deposits. Throughout North America, the silica sand industry is highly competitive on a regional basis and the industry is dominated by a few large producers.

The main modes of transportation to markets are rail, truck, barge and ship. The availability of any one of these transportation methods near a silica sand deposit is essential for a profitable operation. Transporting silica sand is often complex. A silica sand source located substantially closer to its plant can save users hundreds of thousands of dollars per year by reducing transportation costs by only a few dollars per tonne. Lower-priced materials are shipped only to local or regional markets. Prices for actual transactions vary according to geographic region and will take into account the quantity purchased, the application, the quality assurance, the exact grade purchased, the credit terms, and other parameters.

Beneficiation is the key to producing high-quality glass or foundry sand from most deposits. For most applications, the finished sand product must be dried. The following combinations of the processes actually required are a function of the deposit to be mined, the products to be offered, and the markets to be served:

- drying and screening only, which is rarely sufficient;
- washing, drying and screening;
- washing, scrubbing, flotation, drying and screening;
- washing, scrubbing, flotation, drying, screening, and sizing in air separators;
- iron removal (magnetic, wet or dry);
- grinding, regardless of other processes used, if required by the grain size distribution of plant feed;
- acid leaching for high-purity products;
- bagging facilities for some or all products; and
- cooling facilities for foundry sand.

SUPPLY

Canada's silica comes from the Random formation, the Precambrian Bar River Quartzite formation, the Postdam Sandstone (Upper Cambrian) formation, the Winnipeg formation, and some Pleistocene and other formations (e.g., glacial deposits and dune sands).

The distance from the consumer plays a very important role in the delivered price of silica sand. There are many small operations that supply local markets. Some of the most important Canadian producers are described below.

The provinces of Quebec, Ontario and Alberta are the main producers of silica in Canada, followed by Saskatchewan, British Columbia and Nova Scotia. The production (i.e., shipments) of silica in Canada, as reported by producers, was 1 519 706 t in 2000, a decrease of 64 480 t from the previous year. The production value also declined, going from $41.3 million in 1999 to $40.8 million in 2000.

In **Newfoundland and Labrador**, Shabogamo Mining and Exploration Co. Ltd. began mining its Roy's Knob quartzite deposit near Labrador City in October 1999. The company's washing and screening plant is located in Wabush, Labrador. The quartzite product is sent by rail to Sept-Îles, Quebec. The official opening ceremony of the operation took place on November 20, 1999. Shabogamo has a contract to supply quartzite to Bécancour Inc. of Quebec, which uses the material to manufacture silicon metal. The first shipment was made in February 2000. The company also shipped three loads of quartzite to Europe for use in the silicon metal industries.

In **Nova Scotia**, Shaw Resources, a member of The Shaw Group Limited, produces a high-purity (98.5-99.5%) silica from sand deposits located near Shubenacadie. The silica is mainly used in sandblasting, as foundry sand and as filter sand. In addition, fines from its silica operation are beneficiated to flint glass-grade material. Fine sand products are sold in the Maritimes, Quebec and the northeastern United States for use in sandblasting, filter sand, traction sand, cement and concrete manufacturing, refractory use and decorative sand, and as a flux for base-metal smelters; the sand could also be used in glass-making.

In **New Brunswick**, Shaw Resources, Chaleur Silica (a division of The Shaw Group Limited) manufactures abrasive products using raw material from Nova Scotia, Ontario and the United States. It also produces silica for use as a flux at the Belledune lead smelter and for use in cement manufacture.

Atlantic Silica Inc., a subsidiary of Baskatong Quartz Inc. of Quebec, mines a high-grade (+98%) silica deposit near Sussex for use in sandblasting, silicon metal, silicon carbide, foundry sand, filtration sand and ornamental sand. Most of it is used in eastern Canada, although some is shipped to the United States.

In **Quebec**, Unimin Canada Ltd., a subsidiary of Unimin Corp. of the United States, is the largest producer of silica. Silica is mined from a quartzite deposit at Saint-Donat-de-Montcalm and from a sandstone deposit at Saint-Canut. Silica from Saint-Donat is shipped and refined at the Saint-Canut plant near Montréal. Most of the silica produced by Unimin originates from Saint-Canut where the ore is ground, screened and beneficiated by magnetic separation. Most of Unimin's output is used in the production of glass containers, flat glass and fibreglass, and also in the silicon carbide industries.

Bécancour Chemical Industries operates the silica plant in Bécancour that was previously owned by SKW Canada Inc. It also owns the quartzite deposit north of La Mabaie that is being developed by Sitec Inc. Sitec is the newly formed joint venture between Baskatong Quartz Inc., which produces high-purity quartz, and SOQUEM INC., a wholly owned subsidiary of SGF Minéral Inc.

La Compagnie Bon Sable Ltée mines silica sand at Saint-Joseph-du-Lac and Ormstown. The material is used mainly for sandblasting and as concrete sand, and is suitable for the production of fibreglass.

Les Sables Silco Inc. mines and grinds its silica at its plant in Sainte-Clothide, Chateauguay County. The products are sold to a chemical company, cement plant and ferromanganese plant.

Temisca inc., which mines and processes silica near Saint-Bruno-de-Guigues, supplies the golf course, filtration, frac, abrasives and construction markets and was recently sold to Stake Technology Ltd. (StakeTech) of Norval, Ontario. The company is particularly interested in developing the frac sand business for the oil and gas industry since the deposit contains an unusually large-grained sand that is normally found only in Texas in the United States.

In **Ontario**, Unimin Canada Ltd. is also the largest producer of silica with a reported total capacity of about 550 000 t/y. Lump quartzite from Badgeley Island (150 000-t/y capacity) in northern Georgian Bay is shipped by lake boat to Canadian destinations for the manufacture of ferrosilicon. The finer material, produced by grinding, is shipped to Unimin's plant at Midland (400 000-t/y capacity), south of Georgian Bay, where it is further processed to a glass-grade silica sand and silica flour for ceramic and other uses.

Other significant producers are: Arriscraft International Inc. with its Elgin Quarry, Damron Minerals with its Ellis Quarry, Great White Minerals Ltd. with its Fripp Quarry, Inco Limited with its Lawson Quarry, and Hunt Engineering Group with its Penhorwood and Roseval quarries.

In **Manitoba**, there are no currently operating silica quarries. Selkirk Silica, based in Selkirk, Manitoba, imports silica sand from Minnesota and packages it for resale. Silica sand and quartz resources are found in southeastern Manitoba and a limited amount of investigation has been carried out by a number of companies (e.g., Gossan Resources Limited).

In **Saskatchewan**, Hudson Bay Mining and Smelting Co., Limited (HBMS) produces silica in the Amisk Lake area of northern Saskatchewan and is the largest user of the province's silica sand at its Flin Flon, Manitoba, smelter. HBMS uses sand as a fluxing agent which, in the molten state, reacts with various impurities in the copper and zinc ore and produces a slag. The slag produced in the smelter, with the impurities, is drawn off, leaving a more refined metal behind.

Red Deer Silica Inc. produces a small amount of silica northeast of the village of Hudson Bay, Saskatchewan. The main market is for golf course bunkers, stucco sand and sandblasting sand.

In October 2000, Hanson Lake Silica, a subsidiary of Daren Industries Ltd. of Vancouver, B.C., began processing silica sand from the Winnipeg Formation on the southwestern shore of Hanson Lake, about 100 km west of Flin Flon. The company plans to sell its product to the western Canada frac sand market. Preliminary sizing is done at the quarry to screen out the fines before the sand is trucked about 15 km to a processing plant where washing, drying and final sizing are completed. From the processing plant, the sand will be trucked about 150 km to a distribution facility the company is establishing in Mean Park, north of Prince Albert, Saskatchewan.

In **Alberta**, Sil Silica Inc. of Edmonton, which produces silica sand from local sand dunes in the Bruderheim area, has changed its name to Sil Industrial Minerals Inc. The company operates a silica processing facility near Edmonton. The silica is sold mainly for the manufacture of fibreglass and as sandblasting material. Other uses include foundry sand, filtration sand, fracturing sand and railway traction sand. The company also produces silica flour by processing the silica sand through a ball mill; the flour is used in thermal insulating cement in the oil and gas industries.

United Industrial Services Ltd. (UIS) of Calgary, Alberta, began operations at its new silica sand plant near Peace River, Alberta, in the summer of 2000. The company's foundry, fibreglass and frac sand, along with the reprocessing of frac sand, are for customers in the northwestern United States and western Canada.

In **British Columbia**, Mountain Minerals Co. Ltd., a division of Highwood Resources Ltd. of Calgary, Alberta, mines a high-purity (99.5%) silica sand for diverse industrial applications (e.g., glass grade) at the Moberly mine in the Golden area. The friable sandstone is ground, screened, washed, dried and separated into several sizes at a plant near Golden, B.C. These different sizes are sold mainly as glass sand, but also as sandblasting sand, foundry sand, filter media sand and golf course sand. In addition, the company produces lump silica that is used in the production of silicon.

In 2000, Monteith Bay Resources Ltd. supplied 37 000 t of silica to the Tilbury Cement Ltd. plant in Delta from its Monteith Bay quarry on western Vancouver Island.

OUTLOOK

Paul Guttmann, Vice-President of Marketing for U.S. Silica Company, told participants at the Blendon Twelfth Annual Canadian Conference on Markets for Industrial Minerals that the total silica market in North America is well over 30 Mt/y. He stated that Canada and Mexico together account for 15% of silica use while the United States accounts for the remaining 85%.

In addition, Freedonia, in its *U.S. Industry Study on Specialty Silicas* of May 2000, predicted that U.S. demand for specialty silicas will rise by 5.2% per year. That growth will continue to be driven by robust advances in new applications such as chemical mechanical planarization (CMP) slurries, high-performance and/or specialty tire fillers, and ink jet paper coatings. All of these are applications that require precipitated silica and fumed silica.

According to Freedonia, growth will also be driven by stellar gains in tire applications as U.S. producers finally begin larger-scale use of silica as a filler and reinforcement in tires although, for the time being, its success will mainly be in niche markets such as truck tires, winter tires and high-performance tires. Electronics will be the fastest growing market for silica. Gains will result almost entirely from the CMP slurry market, which is growing rapidly due to changes in integrated circuit designs that require smaller and smaller line widths. Sales in this application have nearly tripled since 1994 and double-digit growth will continue through 2004.

In addition, it should be noted that:

- the glass container industry will continue to increase its level of recycling, which will result in a reduction in the use of silica and other industrial minerals used in glass-making;
- the market for flat glass is expected to continue to grow faster than the economy, and the markets for fibreglass (i.e., insulation and reinforcements) are dependent on construction (i.e., housing);
- competition from U.S. silica producers for glass and foundry sand will remain strong in Ontario and Quebec because of the proximity of these provinces to the low-cost producers of the Great Lakes region;
- the recycling of silica sand at foundries means that no real growth can be expected in the foundry sand industry in Canada; and
- the use of silica in sandblasting should decline as a result of tighter environmental controls and its substitution by other minerals such as garnet, olivine, staurolite and feldspar.

OPPORTUNITIES

Canada is in a good position to attract new silica production facilities, especially in British Columbia, Quebec, Labrador, and possibly Manitoba, where electricity is readily available and very competitive, and high-purity silica is either available or could be recovered from deposits not yet being mined.

The production of silicon carbide (SiC) is electricity-intensive (7-10 kWh/t SiC), and new production facilities could be built in Canada to supply the U.S. market, which has become very dependent on Chinese imports in recent years.

High-value silica products could be produced in Canada because of the low cost of electricity in certain parts of the country, including:

- cultured quartz in western Canada for the production of oscillators used in electronics, optical instruments and other applications;
- fused amorphous silica or quartz (minimum 99.8% SiO_2) in the form of ingots, rods, tubes and powder for the chemical and electronic industries;
- cristobalite for use as a filler (infrared anti-block) in plastics, in abrasive paints on roads, as a partial substitute for TiO_2 in paints, and as a refractory product;
- high-purity ground silica (minimum 99.5% SiO_2, 2-20 microns) for use as an abrasive for metal polishes and cleansers, and as fillers in plastics and rubber;
- monocrystalline silicon for the production of silicon chips;
- chemical-grade silicon metal for the production of silicones in western Canada;
- integrated silicon carbide plants in both eastern and western Canada, based on local raw materials and inexpensive electricity;
- the production of silicones by reacting silicon metal powder with methyl chloride;
- the production of fumed amorphous silica from the hydrolysis of silicon tetrachloride in a flame of hydrogen and oxygen for use in rubbers; as a thickening agent in inks, paints, cosmetics, etc.; for use in polyester; and in specialty coatings such as powder coatings; and
- precipitated silica and silica gel by reacting sodium silicate with sulphuric acid (these products are used for reinforcing rubber, in toothpastes, as extenders in paints, as fillers in inks, and as thickener in batteries).

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Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of June 29, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada MFN	 GPT	 USA	United States Canada
2804.61	Silicon containing by weight not less than 99.99% of silicon	8.5%	6%	Free	Free
2804.69	Silicon, n.e.s.	8.5%	6%	2.7%	1.5%-2.7%
2811.22	Silicon dioxide	11.8%	8%	Free	Free
2849.20	Silicon carbide	Free	Free	Free	Free
7202.21.10	Ferrosilicon containing by weight more than 55% but less than 60% of silicon	Free	Free	Free	Free
7202.21.20	Ferrosilicon containing by weight 60% or more of silicon but less than 90%	1.44¢/kg on the silicon content	Free	Free	Free
7202.21.30	Ferrosilicon containing by weight 90% or more of silicon	4.11¢/kg on the silicon content	Free	Free	Free
7202.29	Ferrosilicon, n.e.s.	Free	Free	Free	Free
7202.30	Ferro-silico-manganese	1.44¢/kg or fraction thereof on the manganese content	Free	Free	Free
7202.50	Ferro-silico-chromium	9.5%	6.5%	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.
n.e.s. Not elsewhere specified.

TABLE 1. SILICA, CANADIAN PRODUCTION AND TRADE, 1999 AND 2000

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)					
	By province and territory				
	Newfoundland	x	x	x	x
	Prince Edward Island	–	–	–	–
	Nova Scotia	x	x	x	x
	New Brunswick	x	x	x	x
	Quebec	528 707	13 785	563 000	13 940
	Ontario	567 208	12 285	477 958	11 630
	Manitoba	x	x	x	x
	Saskatchewan	–	–	–	–
	Alberta	272 189	8 500	262 066	8 450
	British Columbia	x	x	x	x
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	1 584 186	41 349	1 519 706	40 808
IMPORTS[1]					
2505.10	Silica sands and quartz sands				
	United States	361 961	40 023	312 270	44 802
	Germany	1 451	1 222	1 461	804
	China	28	8	548	506
	South Africa	552	316	1 448	410
	Sweden	168	158	491	308
	Other countries	1 419	536	1 345	641
	Total	365 579	42 263	317 563	47 471
2506.10	Quartz (other than natural sands)				
	United States	5 985	319	18 828	1 052
	France	3	. . .	10 725	456
	Spain	42 771	2 086	10 072	423
	Other countries	2 960	153	6 377	283
	Total	51 719	2 558	46 002	2 214

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
2506.21	Quartzite, crude or roughly trimmed				
	United States	800	171	949	211
	Guatemala	–	–	20	6
	Other countries	10	3	–	–
	Total	810	174	969	217
2506.29	Quartzite n.e.s.				
	United States	1 886	135	2 094	136
	Brazil	772	44	583	49
	Japan	110	7	503	41
	Other countries	1 658	89	128	11
	Total	4 426	275	3 308	237
2811.22	Silicon dioxide				
	United States	19 666	42 062	21 591	41 135
	Germany	846	4 297	1 633	7 647
	Mexico	5	14	1 026	1 677
	China	292	595	259	684
	Japan	318	1 290	107	562
	Other countries	510	1 494	285	1 041
	Total	21 637	49 752	24 901	52 746
EXPORTS					
2505.10	Silica sands and quartz sands				
	United States	311 413	5 029	370 528	4 740
	Norway	9 475	332	9 567	318
	Chile	159	39	147	52
	Other countries	68	17	260	55
	Total	321 115	5 417	380 502	5 165
2506.10	Quartz (other than natural sands)				
	United States	99	104	1 708	459
	Bulgaria	–	–	538	35
	Taiwan	–	–	508	28
	Total	99	104	2 754	522
2506.21	Quartzite, crude or roughly trimmed				
	Norway	–	–	10 250	520
	United States	471	182	673	263
	Total	471	182	10 923	783
2506.29	Quartzite n.e.s.				
	United States	84	17	180	69
	Philippines	23	14	–	–
	Total	107	31	180	69
2811.22	Silicon dioxide				
	United States	25	122	90	340
	Singapore	–	–	3	31
	Other countries	61	61	47	8
	Total	86	183	140	379

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; x Confidential.
[1] Includes sand for use in foundries and glass manufacturing, ground and flour sand, and volatized and silica flue dust.
Note: Numbers may not add to totals due to rounding.

TABLE 2. IMPORTS OF SILICA SAND FROM THE UNITED STATES, BY PROVINCE AND BY USE, 1999 AND 2000

	1999		2000p	
	(tonnes)	($000)	(tonnes)	($000)
FOUNDRY				
Newfoundland	–	–	–	–
Prince Edward Island	–	–	–	–
Nova Scotia	700	12 930	1 000	18 467
New Brunswick	–	–	121	8 186
Quebec	4 854	177 754	26 408	616 885
Ontario	131 254	10 442 471	101 215	10 826 747
Manitoba	28 136	1 224 200	26 717	1 098 726
Saskatchewan	199	65 109	220	87 481
Alberta	14 249	590 607	26 910	1 044 663
British Columbia	11 076	563 205	5 717	369 923
Total	190 468	13 076 276	188 308	14 071 078
GLASS MANUFACTURING				
Newfoundland	–	–	–	–
Prince Edward Island	–	–	–	–
Nova Scotia	152	77 222	298	95 326
New Brunswick	–	–	–	–
Quebec	6 385	728 845	646	136 138
Ontario	104 438	2 573 192	62 768	2 173 250
Manitoba	10	6 031	6	3 275
Saskatchewan	–	–	–	–
Alberta	2 369	127 132	758	28 545
British Columbia	96	36 353	72	59 782
Total	113 450	3 548 775	64 548	2 496 316

Source: Statistics Canada.
– Nil; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 3. REPORTED USE[1] OF SILICA IN CANADA, BY INDUSTRY, 1998 AND 1999

	1998	1999p
	(tonnes)	
Primary glass and glass containers, and glass fibre wool	665 001	662 046
Nonferrous smelting and refining	520 917	506 900
Foundries	310 355	305 858
Chemicals	63 220	62 498
Abrasives	62 773	50 977
Other products[2]	1 112 930r	1 119 829
Total	2 735 196r	2 708 108

Source: Natural Resources Canada.
p Preliminary; r Revised.
[1] Available data, as reported by users. [2] Includes asbestos products, asphalt roofing products, cement, ceramic products, structural clay products, cleansers, fertilizers, paint and varnish, pulp and paper products, refractory brick, rubber products, ferroalloys, primary steel, and other miscellaneous products.

TABLE 4. SILICA USE[1] IN CANADA, 1998 AND 1999

	1998	1999[p]
	(tonnes)	
Sand	1 486 835[r]	1 467 848
Lump	1 149 326	1 144 408
Flour	99 035	95 852
Total	2 735 196[r]	2 708 108

Source: Natural Resources Canada.
[p] Preliminary; [r] Revised.
[1] Available data, as reported by users.

TABLE 5. SOME USES OF QUARTZITE SILICA

most forms of glass
stone facing
car and bike tire additive
ceramics
fibre optics
fibreglass insulation
landscape rock
casting of molds
grout
pool coatings
crystal
aquarium gravel
chemical industry
paint life enhancer
golf sand traps
road asphalt enhancer
waterproof sewer pipe
building adhesive products
water filtration
iron foundries
fibre cement
acid-proof cement
abrasives
water treatment
sand blasting
home siding
absorbent
brick and tile
frac drillers sand
fireproof material

Source: Real Silica Inc. web site (www.silica.org/index.htm).

TABLE 6. PARTICULAR SILICA RAW MATERIALS FOR USE IN SPECIFIC APPLICATIONS (EXAMPLES)

Silica sand

Glass and glass fibre
Silicon carbide
Hydraulic fracturing
Foundry sand
Sodium silicate
Sand blasting and sand paper
Filler media in water treatment
Portland cement manufacture

Lump silica

Flux: massive quartz, quartzite, sandstone, unconsolidated sands
Silicon, ferrosilicon and silicon alloys: lump quartz, quartzite, well-cemented sandstone
Silica brick: quartz, quartzite and garnisher
Aggregate: quartz and quartzite
Lining material in ball and tube mills
Lining and packing for acid towers
Grinding pebbles

Silica flour

Ceramics, enamels, frits, pottery flint
Filler, rubber, asbestos cement
Extender in paint
Abrasive in soap and scouring pads
Autoclave-cured concrete products

Quartz crystal

Electronics for its piezoelectric properties
Fusing quartz

Source: *Industrial Minerals* (magazine), April 1987, p. 25.

TABLE 7. SPECIALTY SILICAS

The processing of silica of specific quality yields several types of specialty silicas. These include colloidal, fumed, fused, high-purity ground, silica gel, and precipitated silica.

- Colloidal silica is mainly used as a high-temperature binder for silicon wafer polishing and carbonless paper.

- Fumed silica, because of its unique strength and thixotropic and flatting properties, is a valuable ingredient in rubber, plastics, specialty coatings, adhesives, cement and sealants; it also aids in manufacturing pesticides, cosmetics, pharmaceuticals, defoamers, inks, abrasives and batteries.

- Fused silica is produced by the fusion of very high-quality silica sand feedstock in electric arc and resistance furnaces. The resulting product is very different from the original silica sand due to its extremely high quality, consistent chemistry, high resistance to thermal shock and low thermal conductivity. It is therefore suitable as a filler for electronic encapsulants, refractory and investment castings, and specialty coatings.

- High-purity ground silica is produced from silica sand or soft, friable rocks and is often referred to as amorphous silica. It is used mainly in specialty coatings, plastics, rubber, electronics, abrasives, refractories and optics, depending on its average particle size, distribution, hardness and refractive index.

- Silica gel is an extremely pure, porous and amorphous form of silica known for its high degree of internal surface area, hardness, uniformity and chemical inertness. Its ability to absorb liquids makes it valuable in a wide variety of applications including catalysts, anticaking agents in food and pharmaceutical products, desiccants, cosmetics, plastics, specialty coatings, paper and adhesives.

- Precipitated silica is another type of specialty silica that is mainly used a a reinforcing agent in tire compounds. Its properties also provide anticaking, conditioning, suspension, and viscosity control in products like toothpastes, deodorants, nail polishes and vitamin tablets.

Current prices for the various forms of these specialty silicas range from $140/t to nearly $6600/t.

Source: Web site, Minerals and Energy Branch, Department of Natural Resources, Government of Nova Scotia.

TABLE 8. SILICA APPLICATIONS, QUALITY AND SPECIFICATIONS

Glass-grade: minimum 98.5-99% SiO_2 with Fe_2O_3 of <0.04% (flat glass), 0.03% (flint container), 0.18% (amber container), and 0.3% (fibreglass), 0.2-1.6% Al_2O_3, with limits on alkalis, colourants (nickel, copper, cobalt) and refractory minerals (chromite, zircon, rutile). First-grade optical glass minimum 99.8% SiO_2, <0.1% Al_2O_3 and 0.02% Fe_2O_3. Sodium silicate feedstock >99.4% SiO_2, <0.03% FeO_3. Ceramic-grade (-200 mesh) >97.5% SiO_2, <0.55% Al_2O_3 and 0.2% Fe_2O_3.

Filtration sand: relatively pure and free of dust, clay, and micaceous or organic matter. Grain shape should be angular or round but should not be elongated or flat. A uniform size is required with a narrow particle size distribution, which is measured by effective size (size of a sieve opening that will just pass 10% by weight of a representative sample) and uniformity coefficient (a ratio of the size of a sieve opening that will just pass 60% of a representative sample of the sand to the size of the sieve opening that will just pass 10% [i.e., the effective size] of the same sample). Frac or proppant sand, well-rounded sand with only minor amounts of impurities such as clay, feldspar and calcite (<0.3% solubility in HCl). Common screen sizes are 3.35 x 1.70 mm, 2.36 x 1.18 mm, 1.70 x 0.850 mm, 0.425 x 0.212 mm, and 0.212 x 0.10 mm.

Foundry sand: (-200 mesh) minimum 98% SiO_2 with limits on CaO and MgO in order to reduce the acid demand value (ADV), which is a measure of the binder required. Particle size may be quantified by the American Foundryman's Society grain fineness number, which is approximately the number of openings per inch corresponding to a sieve that would pass a sand sample if its grain were of uniform size, i.e., the average size of grains in the sample. Flux sand (iron and steel) lumpy >90% SiO_2. Refractory sand 95-99% SiO_2. Ground silica and silica flour <0.10% FeO_3, <0.38% Al_2O_3, <0.10% NaO, <0.10% K_2O. Flour has an average particle size of 60 microns. Both require a brightness of +89%.

Silicon feedstock: >98.5-99% SiO_2, <0.1-1.5% Fe_2O_3, <0.15% AlO_3, no P or As, <0.2% CaO, MgO, and LOI with lumps >2.54 cm in diameter and a minimum softening point of 1700°C and decrepitation point of 950°C; ferrosilicon >98% SiO_2, <0.2% Fe_2O_3, 0.4% Al_2O_3, 0.2% CaO and MgO, and 0.1% P with lumps of 0.32-10.16 cm in diameter; SiC >99.7% SiO_2, <0.05% Fe_2O_3 and Al_2O_3, 0.01% CaO, and 5% moisture; cultured and synthetic quartz Fe, Al, transition elements, alkali content measured in the <100 and even <10 ppm ranges.

Source: *The Industrial Minerals HandyBook*, 3rd Edition, Peter W. Harben, p. 188.

Stone

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The volume of all types of stone shipped in Canada in 2000 was approximately 112 Mt based on preliminary figures. This amount is about 3% higher than in 1999. The reported value of total shipments in 2000 was about $822 million; this is 6% higher than the previous year. Shipments served a very wide range of uses related to dimension stone, chemical and metallurgical grades of stone, pulverized stone and crushed stone, as shown in Table 2, which follows the trade data summarized in Table 1.

Shipments of crushed stone (mainly chemical-grade limestone) for producing cement, as well as lime, are essentially accounted for in separate chapters entitled *Cement* and *Lime*. Additional detailed information on regular aggregates, including crushed stone and sand and gravel, as well as on lightweight aggregates, is included in a separate chapter entitled *Mineral Aggregates*. The lightweight aggregates included are: expanded shales/clays, perlite, vermiculite, pumice, and expanded ferrous slags or granules.

Dimension or ornamental stone relates to a variety of rock types that can be cut, shaped or simply selected for a broad range of construction/engineering, architectural or monumental requirements. The types of stone available are dependent on local geology, but mainly include granite, limestone, marble, sandstone and slate, as summarized in Tables 3 to 8 inclusive. The term "granite," as commercially applied, includes true granite, granodiorite, gneiss, and other medium- to coarse-grained igneous rocks. However, "black granite" includes anorthosite and other dark-coloured igneous rocks. Limestone and marble are often confused, marble being the metamorphosed equivalent of the former and usually including both dolomitic and calcitic varieties. As an industrial term, "marble" refers to recrystallized calcareous rock capable of taking a polish.

Detailed information on the Canadian stone industry can be found at provincial government web sites relating to natural resources (accessible through Natural Resources Canada's Internet site at http://www. nrcan.gc.ca/mms/prov2-e.htm). Also, the commercial names relating to many rough and finished stone products are found at the Canadian Stone Association's (CSA) web site at www.stone.ca. The names of suppliers of relevant goods and services are also listed at this site.

Recent major developments in the dimension stone industry in Canada include: 1) the acquisition of Stony Creek Granite Co., of Branford, Connecticut, by Granicor inc., of St. Augustine, Quebec; 2) the start of construction of a $20 million granite-processing plant in Argentia, Newfoundland; 3) the re-opening of the Hardy Island granite quarry, situated about 20 km southeast of Powell River, British Columbia; and 4) the installation of a second gangsaw by West Coast Granite Manufacturing Inc. of Delta, British Columbia. This operation accounts for the only granite slabbing operation on North America's west coast.

In 2000, the value of exports of rough granite increased to $19.4 million (Table 1), an increase of nearly 18% compared to 1999. Also, exports of value-added worked granite for building and monumental needs, mainly to the United States, increased to about $65 million, representing a 14% increase compared to 1999. Plant modernizations by several stone producers across Canada have increased the availability of high-quality finished products at competitive prices. The value of output of all worked construction- and monument-related granite (f.o.b. manufacturing plant) serving both domestic and international markets is expected to be maintained at about $125 million annually.

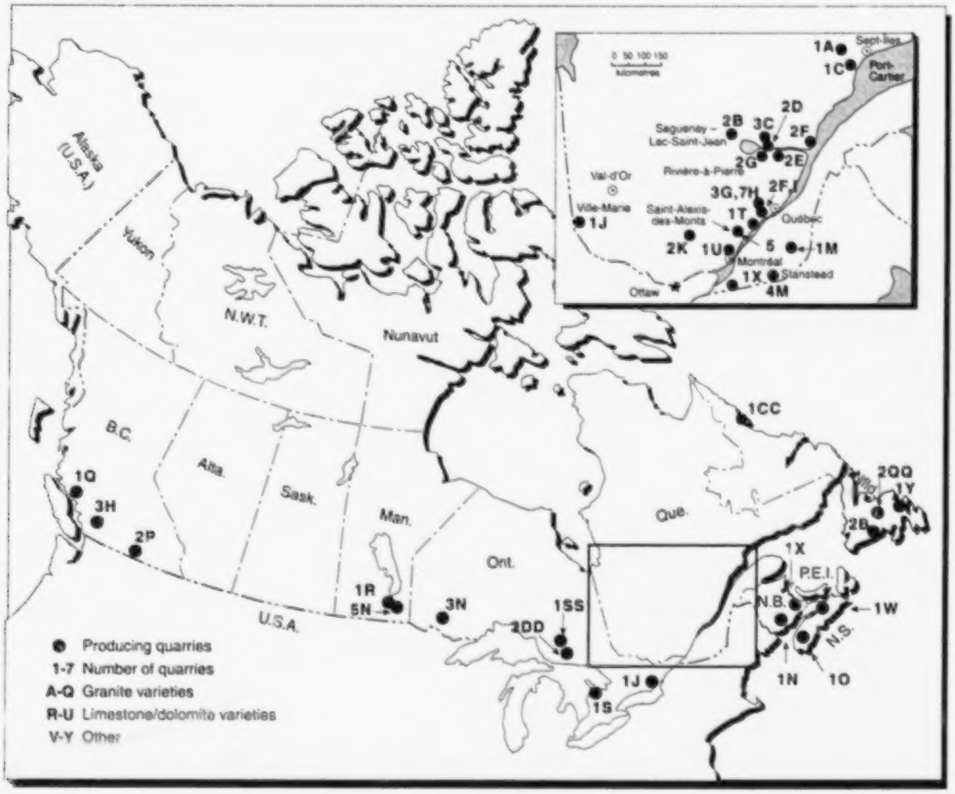
It is expected that growth in the use of dimension stone in Canada will continue in 2000/01, based mainly on the positive outlook for all construction, including new expenditures for office buildings in some cities. However, exports of rough granite and worked granite, as well as other stone products, are expected to be weaker based on a slowdown in demand in some U.S. markets. Slate is becoming more important in world markets for its natural unpolished appearance, its non-slippery and multi-coloured durable surfaces, and its relatively low price.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of February 1, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

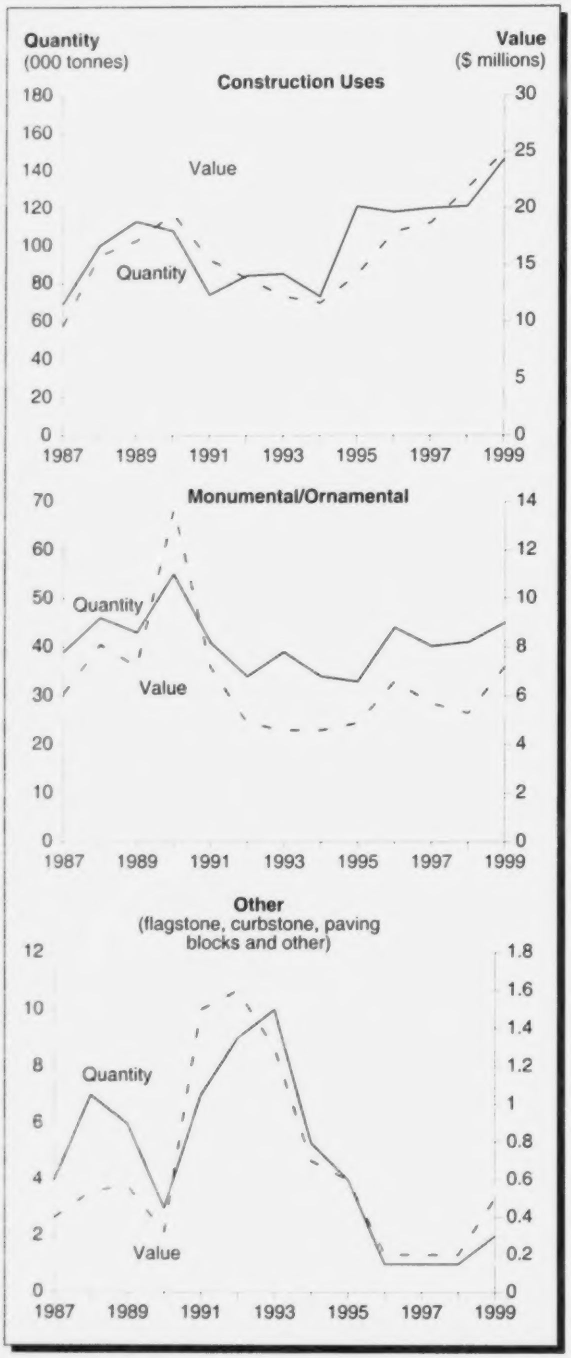
Figure 1
Canada, Architectural and Monumental/Ornamental Stone-Producing Centres, 1999


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1Q
3H
2P
1R
5N
3N
2DD
1SS
1S
1J
1CC
2QQ
1Y
2B
1X
1W
1N
1O
0 50 100 150
kilometres
1A
Sept-Îles
1C
Port-Cartier
2D
Saguenay - Lac-Saint-Jean
2B
3C
2F
2G
2E
Rivière-à-Pierre
Val-d'Or
3G,7H
2F,I
Ville-Marie
1J
Saint-Alexis-des-Monts
1T
Québec
2K
1U
5
1M
Montréal
1X
Stanstead
Ottawa
4M
● Producing quarries
1-7 Number of quarries
A-Q Granite varieties
R-U Limestone/dolomite varieties
V-Y Other

A	Fine-grained pinkish-grey banded gneiss
B	Medium-grained pink granite
C	Coarse-grained black anorthosite
CC	Medium-grained "Reflect blue" anorthosite
D	Medium-grained black gabbroic anorthosite
DD	Blue-grey, and black and white anorthosite
E	Medium-grained pinkish-grey quartz monzonite
F	Fine-grained pink granitic gneiss
G	Coarse-grained green charnockite
H	Coarse-grained pink-grey or brown-grey granite
I	Medium-grained grey dioritic gneiss
J	Medium-grained red granite
K	Fine-grained pink aplite
L	Coarse-grained brown or red quartz monzonite
M	Medium-grained grey granite
N	Medium-grained pink, brown or gold granites
O	Fine-grained blue-grey granite
P	Coarse coral pink granite
Q	Medium-grained blue-grey granite
QQ	Medium-grained gabbro
R	Light-coloured mottled dolomitic limestone (Tyndall)
S	Fine-medium crystalline blue-grey to buff marble/dolostone (Arriscraft)
SS	Fine-grained, multicoloured pre-Cambrian marble
T	Medium-grained light brownish-grey limestone (Deschambault)
U	Medium-grained blue-grey limestone (Chazy)
V	Medium-grained olive sandstone
W	Fine-medium-grained olive-brown and blue-grey sandstone
X	Fine-medium-grained white to buff sandstone (Potsdam)
Y	Very fine-grained varicoloured slate

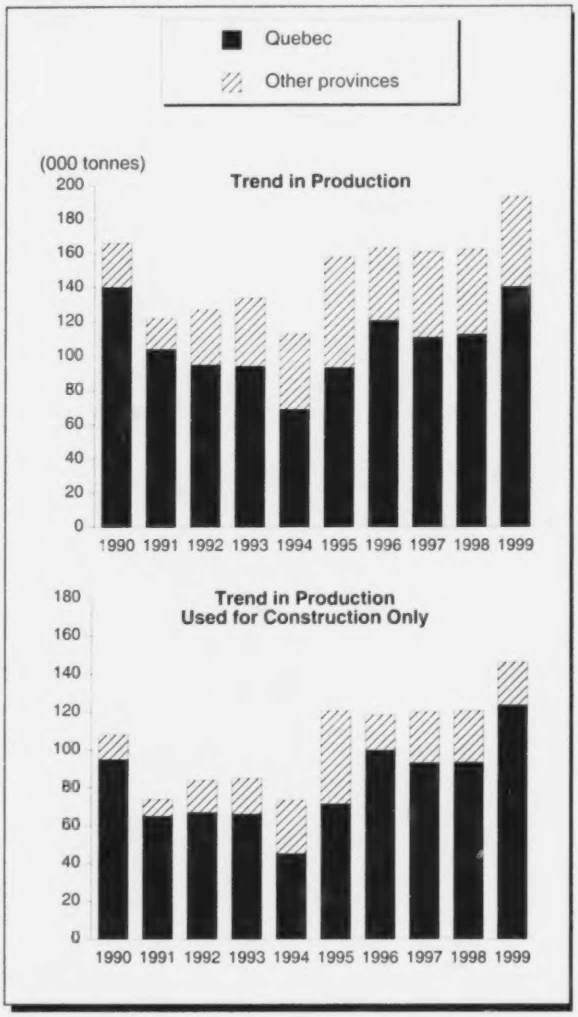
Source: Mainly provincial departments of Mines and Energy.

Figure 2
Canada, Production of Rough Granite (Sold and Used by Producers), 1987-99



Sources: Natural Resources Canada; Statistics Canada.

Figure 3
Canada, Trends in Production of Rough Dimensional Granite for Construction, Monumental/Ornamental and Other Uses, 1990-99



Sources: Natural Resources Canada; Quebec Ministry of Natural Resources.

TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2514.00	Slate, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
2514.00.10	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
2514.00.90	Other	Free	Free	Free	Free
25.15	Marble, travertine, ecaussine and other calcareous monumental or building stone of an apparent specific gravity of 2.5 or more, and alabaster, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Marble and travertine:				
2515.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2515.12.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free	Free	Free	Free
2515.20	Ecaussine and other calcareous monumental or building stone; alabaster				
2515.20.10	Crude or roughly trimmed	Free	Free	Free	Free
2515.20.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.16	Granite, porphyry, basalt, sandstone and other monumental or building stone, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Granite:				
2516.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.12	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free-3.5%	Free	Free	Free
	Sandstone:				
2516.21.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.22.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
2516.90	Other monumental or building stone				
2516.90.10	Crude or roughly trimmed	Free	Free	Free	Free
2516.90.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.17	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates, for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated; macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in the first part of the heading; tarred macadam, granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated				
2517.10.00	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated	Free	Free	Free	Free
2517.20.00	Macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in subheading no. 2517.10	Free	Free	Free	Free

TARIFFS (cont'd)

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2517.30.00	Tarred macadam	6.5%	Free	Free	Free
	Granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated:				
2517.41.00	Of marble	Free	Free	Free	Free
2517.49	Other				
2517.49.10	Limestone roofing granules	Free	Free	Free	Free
2517.49.90	Other	Free	Free	Free	Free
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	3.5%	Free	Free	Free
68.02	Worked monumental or building stone (except slate) and articles thereof, other than goods of heading no. 68.01; mosaic cubes and the like, of natural stone (including slate), whether or not on a backing; artificially coloured granules, chippings and powder, of natural stone (including slate)				
6802.10	Tiles, cubes and similar articles, whether or not rectangular (including square), the largest surface area of which is capable of being enclosed in a square that is less than 7 cm; artificially coloured granules, chippings and powder				
6802.10.10	Roofing granules, artificially coloured	Free	Free	Free	Free
6802.10.90	Other	8%	5%	Free	Free
	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface:				
6802.21.00	Marble, travertine and alabaster	3.5%	Free	Free	Free
6802.22.00	Other calcareous stone	5%	Free	Free	Free
6802.23.00	Granite	3.5%	Free	Free	Free
6802.29.00	Other stone	5%	Free	Free	Free
	Other:				
6802.91.00	Marble, travertine and alabaster	6%	Free	Free	Free
6802.92.00	Other calcareous stone	6.5%	3%	Free	Free
6802.93.00	Granite	6.5%	6.5%	Free	Free
6802.99.00	Other stone	6.5%	6.5%	Free	Free
6803.00	Worked slate and articles of slate or of agglomerated slate				
6803.00.10	Roofing slate; slate for use in the manufacture of billard tables	Free	Free	Free	Free
6803.00.90	Other	6.5%	6.5%	Free	Free
68.04	Millstones, grindstones, grinding wheels and the like, without frameworks, for grinding, sharpening, polishing, trueing or cutting, hand sharpening or polishing stones, and parts thereof, of natural stone, of agglomerated natural or artificial abrasives, or of ceramics, with or without parts of other materials				
6804.10.00	Millstones and grindstones for milling, grinding or pulping	6.5%	Free	Free	Free
6804.23.00	Of natural stone	6.5%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, STONE EXPORTS AND IMPORTS, 1998-2000

Item No.		1998		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2514.00	Slate, whether or not roughly trimmed or merely cut, etc.	173	209	84	129	271	137
2515.11	Marble and travertine, crude or roughly trimmed	474	377	60	43	4	4
2515.12	Marble and travertine, merely cut, by sawing or otherwise, into blocks, etc.	1 798	884	403	193	633	440
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.11	Granite, crude or roughly trimmed	23 755	12 910	25 763	14 056	28 260	13 163
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.12	Granite, merely cut, by sawing or otherwise, into blocks, etc.	5 798	2 100	4 126	2 431	19 379	6 248
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.21	Sandstone, crude or roughly trimmed	4	20	30	4	15	13
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.22	Sandstone, merely cut, by sawing or otherwise, into blocks, etc.	208	214	96	56	118	56
2516.90	Monumental or building stone, n.e.s.	8 349	2 140	4 467	1 091	3 151	806
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.	3 202 248	29 467	3 358 128	35 245	3 776 891	35 212
2517.41	Marble granules, chipping and powder of 25.15 or 25.16, heat-treated or not	244 573	27 275	267 194	37 958	347 873	56 015
2517.49	Granules, chippings and powder, n.e.s. of 25.15 or 25.16, heat-treated or not	1 732	206	41 155	1 139	100 853	6 103
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	. .	686	. .	1 467	. .	1 631
6802.10	Tiles, etc., rectangular or square not more than 7 cm, etc., artificially coloured granules, chippings and powder	. .	3 667	. .	5 541	. .	35 739
6802.21	Monumental or building stone, cut or sawn, flat or even, marble, travertine and alabaster	. .	413	. .	171	. .	39
6802.22	Monumental or building stone, cut or sawn, flat or even, other calcareous stone	. .	191	. .	102	. .	73
6802.23	Monumental or building stone, cut or sawn, flat or even, granite	. .	3 446	. .	3 099	. .	1 903
6802.29	Monumental or building stone, cut or sawn, flat or even, n.e.s.	. .	1 204	. .	2 089	. .	901
6802.91	Worked monumental or building stone, n.e.s., marble, travertine or alabaster	. .	1 437	. .	2 330	. .	1 403
6802.92	Worked monumental or building stone, n.e.s., calcareous stone, n.e.s.	. .	2 078	. .	1 649	. .	4 196
6802.93.10	Worked building stone of granite	. .	16 257	. .	21 338	. .	26 407
6802.93.90	Worked monumental or building stone, n.e.s., granite	. .	33 167	. .	35 672	. .	38 690
6802.99	Worked monumental or building stone, n.e.s.	. .	25 241	. .	33 542	. .	31 566
6803.00	Worked slate and articles of slate or agglomerated slate	. .	4 720	. .	7 840	. .	11 148
6804.10	Millstones and grindstones for milling, grinding or pulping	. .	5 027	. .	4 927	. .	4 292
6804.23	Millstones, grindstones, etc., of natural stone	. .	2 159	. .	1 104	. .	538

TABLE 1 (cont'd)

Item No.		1998		1999		2000^{p}	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS							
2514.00	Slate, whether or not roughly trimmed or merely cut, etc.	3 075^{r}	1 317	2 731	1 279	4 298	2 080
2515.11	Marble and travertine, crude or roughly trimmed	1 461	760	1 760	851	1 627	810
2515.12	Marble and travertine, merely cut, by sawing or otherwise, into blocks, etc.	1 420	1 346	1 293	866	1 432	978
2516.11	Granite, crude or roughly trimmed	70 554	20 080	64 938	20 044	62 018	18 336
2516.12	Granite, merely cut, by sawing or otherwise, into blocks, etc.	4 630^{r}	2 924	3 833	3 106	3 961	3 468
2516.21	Sandstone, crude or roughly trimmed	3 484	442	7 184	803	6 002	625
2516.22	Sandstone, merely cut, by sawing or otherwise, into blocks, etc.	5 397	1 633	5 306	1 671	5 268	1 749
2516.90	Monumental or building stone, n.e.s.	5 923^{r}	1 832	5 440	1 555	9 889	3 108
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.	3 209 004	18 909	3 188 098	17 887	3 125 368	17 315
2517.41	Marble granules, chipping and powder of 25.15 or 25.16, heat-treated or not	104 178	17 170	88 644	15 250	59 153	10 424
2517.49	Granules, chippings and powder, n.e.s. of 25.15 or 25.16, heat-treated or not	40 583	1 744	26 569	1 399	29 944	1 724
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	. .	631	. .	392	. .	436
6802.10	Tiles, etc., rectangular or square not more than 7 cm, etc., artificially coloured granules, chippings and powder	. .	587	. .	642	. .	795
6802.21	Monumental or building stone, cut or sawn, flat or even, marble, travertine and alabaster	. .	10 597^{r}	. .	10 737	. .	11 248
6802.22	Monumental or building stone, cut or sawn, flat or even, other calcareous stone	. .	216	. .	349	. .	252
6802.23.00.10	Granite, cut or sawn flat or even, bulding stone	2 901	4 102	4 713	5 903	5 550	6 692
6802.23.00.20	Granite, cut or sawn flat or even, monumental	652	577	481	405	629	769
6802.23.00.90	Granite, cut or sawn flat or even, granite other	6 275^{r}	9 737	7 759	12 140	10 256	14 317
6802.29	Monumental or building stone, cut or sawn, flat or even, n.e.s.	. .	786	. .	2 094	. .	2 381
6802.91	Worked monumental or building stone, n.e.s., marble, travertine or alabaster	. .	18 201^{r}	. .	19 945	. .	20 367
6802.92	Worked monumental or building stone, n.e.s., calcareous stone, n.e.s.	. .	1 606	. .	1 493	. .	2 530
6802.93.00.10	Worked building stone of granite	1 876	3 458	1 878	3 257	1 357	2 028
6802.93.00.20	Worked monumental stone of granite, monuments, bases and markets finished	1 925	2 725	2 014	2 769	2 269	3 601
6802.93.00.90	Worked monumental or building stone, n.e.s., granite	4 283	7 742	5 055	7 098	5 510	8 501
6802.99	Worked monumental or building stone, n.e.s.	. .	2 404	. .	2 755	. .	3 223
6803.00	Worked slate and articles of slate or agglomerated slate	. .	7 783	. .	6 278	. .	8 000
6804.10	Millstones and grindstones for milling, grinding or pulping	. .	2 197	. .	2 068	. .	2 492
6804.23	Millstones, grindstones, etc., of natural stone	. .	978	. .	1 041	. .	842

Source: Statistics Canada.
. . Not available or not applicable; n.e.s. Not elsewhere specified; ^{p} Preliminary; ^{r} Revised.

TABLE 2. CANADA, TOTAL PRODUCTION OF STONE, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY[1]						
Newfoundland	2 606	19 837	3 091	20 206	4 938	29 095
Nova Scotia	7 628	45 348	7 881	48 064	7 951	46 328
New Brunswick	3 500	20 796	4 388	23 141	3 436	19 212
Quebec	32 220	215 171	30 269	218 744	29 375	215 234
Ontario	50 689	344 707	51 258	385 675	55 204	434 935
Manitoba	4 992	24 971	4 314	20 089	4 357	20 342
Alberta	633	5 362	465	4 623	431	4 752
British Columbia	6 321	46 995	7 440	54 505	6 473	49 180
Northwest Territories	336	4 760	78	452	184	2 848
Total	108 924	727 947	109 184	775 499	112 348	821 926
BY USE[2]						
I. Stone (Dimension)						
Dimension stone						
Rough	302	34 100	315	41 031	. .	. .
Monumental and ornamental stone (n.f.)	68	5 691	88	7 939	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	66	8 668	104	13 550	. .	. .
Total dimension stone	436	48 459	507	62 520	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	17 537	99 721	20 718	122 299	. .	. .
Asphalt aggregate	10 398	63 791	11 097	69 608	. .	. .
Road metal	31 135	165 001	30 663	165 040	. .	. .
Railroad ballast (includes traprock)	2 187	16 668	1 830	15 437	. .	. .
Other uses	35 318	181 157	34 873	181 907	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 334	46 555	14 082	50 085	. .	. .
Cement plants, foreign	1 632	7 973	525	1 919	. .	. .
Flux in iron and steel furnaces	3 406	21 830	1 295	10 476	. .	. .
Flux in nonferrous smelters	129	900	101	818	. .	. .
Glass factories	203	3 635	163	2 739	. .	. .
Lime plants, Canada	3 353	18 558	5 261	19 877	. .	. .
Lime plants, foreign	216	1 843	1 229	6 269	. .	. .
Pulp and paper mills	89	1 046	96	1 120	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 748	11 787	1 550	9 360	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	10	395	3	120	. .	. .
Roofing granules	580	25 388	751	27 309	. .	. .
Poultry grit	188	2 080	176	1 775	. .	. .
Stucco dash	25	3 598	25	2 682	. .	. .
Terrazzo chips	4	153	7	303	. .	. .
Rock wool	14	214	26	424	. .	. .
Rubble and riprap	1 415	8 147	942	4 415	. .	. .
Other uses	944	8 350	1 090	8 506	. .	. .
Pulverized stone						
Whiting	48	3 631	274	9 956	. .	. .
Asphalt filler	175	261	178	247	. .	. .
Dusting coal mines	3	219	2	145	. .	. .
Agricultural purposes and fertilizer plants	1 169	17 914	1 049	15 377	. .	. .
Other uses	806	37 892	897	58 632	. .	. .
Total crushed stone	127 066	748 708	128 903	786 848		
Total all stone	127 502	797 167	129 410	849 368	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; p Preliminary.
[1] Data exclude stone used in the Canadian cement, lime and clay industries. [2] Data include stone used in the Canadian cement, lime and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 3. CANADA, PRODUCTION OF LIMESTONE, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY[1]						
Newfoundland	1 710	12 784	1 965	12 318	3 104	18 656
Nova Scotia	211	3 789	172	x	165	x
New Brunswick	544	7 637	601	x	519	x
Quebec	22 101	122 287	21 262	121 681	21 754	128 498
Ontario	47 285	267 250	48 164	287 460	51 884	315 679
Manitoba	4 083	16 675	3 823	15 614	3 911	16 401
Alberta	586	4 102	449	2 739	415	2 452
British Columbia	2 506	22 371	2 691	27 233	3 158	28 631
Northwest Territories	32	56	39	x	51	x
Total	79 058	456 951	79 165	475 758	84 960	518 430
BY USE[2]						
I. Stone (Dimension)						
Dimension stone						
Rough	107	4 403	84	6 852	. .	. .
Monumental and ornamental stone (n.f.)	23	388	34	512	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	49	4 779	67	4 708	. .	. .
Total dimension stone	179	9 570	185	12 072	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	13 916	77 246	16 313	97 286	. .	. .
Asphalt aggregate	5 825	33 294	6 268	38 211	. .	. .
Road metal	23 135	123 931	23 980	129 970	. .	. .
Railroad ballast (includes traprock)	247	1 219	136	969	. .	. .
Other uses	26 234	129 064	25 338	130 307	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 054	45 546	13 336	47 054	. .	. .
Cement plants, foreign	1 632	7 973	467	1 655	. .	. .
Flux in iron and steel furnaces	3 406	21 830	1 295	10 476	. .	. .
Flux in nonferrous smelters	129	900	101	818	. .	. .
Glass factories	158	2 435	137	1 971	. .	. .
Lime plants, Canada	3 353	18 558	5 261	19 877	. .	. .
Lime plants, foreign	216	1 843	1 229	6 269	. .	. .
Pulp and paper mills	89	1 046	96	1 120	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	857	7 680	522	4 573	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	129	974	130	764	. .	. .
Poultry grit	187	1 974	175	1 679	. .	. .
Stucco dash	24	3 540	24	2 604	. .	. .
Rock wool	3	28	3	19	. .	. .
Rubble and riprap	718	2 638	533	2 184	. .	. .
Other uses	701	6 834	805	6 610	. .	. .
Pulverized stone						
Whiting	48	3 631	271	9 878	. .	. .
Asphalt filler	46	155	50	185	. .	. .
Dusting, coal mines	3	219	2	145	. .	. .
Agricultural purposes and fertilizer plants	1 049	15 963	972	13 162	. .	. .
Other uses	126	2 966	133	2 829	. .	. .
Total crushed stone	96 287	511 486	97 577	530 617	. .	. .
Total all stone	96 466	521 056	97 762	542 689	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; p Preliminary; x Confidential.
[1] Data exclude stone used in the Canadian cement and lime industries. [2] Data include stone used in the Canadian cement and lime industries.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, PRODUCTION OF MARBLE,[1] 1998-2000

	1998		1999		2000^p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE						
Quebec	620	14 814	605	x	540	x
Ontario	548	28 890	683	x	769	x
British Columbia	–	–	–	–	. . .	x
Total	1 168	43 704	1 288	66 358	1 309	76 072
BY USE						
I. Stone (Dimension)						
Dimension stone						
Rough	13	699	15	543	. .	. .
Monumental and ornamental stone (n.f.)	–	–	–	–	. .	. .
Other (flagstone, curbstone, paving, blocks, etc.)	1	188	13	1 740	. .	. .
Total dimension stone	14	887	28	2 283	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	166	1 752	164	1 826	. .	. .
Asphalt aggregate	17	112	23	137	. .	. .
Road metal	38	403	34	162	. .	. .
Other uses	220	2 017	141	1 391	. .	. .
Chemical process stone						
Glass factories	45	1 200	27	768	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	3	74	2	60	. .	. .
Roofing granules	16	435	28	756	. .	. .
Poultry grit	. . .	3	. . .	3	. .	. .
Stucco dash	1	16	1	23	. .	. .
Terrazzo chips	4	153	7	303	. .	. .
Rock wool	1	12	–	–	. .	. .
Rubble and riprap	–	–	–	–	. .	. .
Other uses	11	703	11	717	. .	. .
Pulverized stone						
Agricultural purposes and fertilizer plants	121	1 950	77	2 215	. .	. .
Other uses	512	33 989	746	55 715	. .	. .
Total crushed stone	1 154	42 817	1 260	64 075	. .	. .
Total all stone	1 168	43 704	1 288	66 358	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; p Preliminary; x Confidential.
[1] Marble refers to a commercial definition that may also include limestone, travertine and greenstone (serpentinite or amphibole).
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA, PRODUCTION OF GRANITE, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY						
Newfoundland	226	4 001	326	4 516	816	6 118
Nova Scotia	6 153	34 947	6 506	38 796	5 899	35 660
New Brunswick	2 825	12 390	3 450	15 655	2 710	12 440
Quebec	6 885	57 931	5 560	55 314	5 368	52 434
Ontario	2 845	46 990	2 389	x	2 521	x
Manitoba	746	8 196	344	x	292	x
British Columbia	3 780	24 114	4 673	x	3 245	x
Northwest Territories	99	648	29	x	83	x
Total	23 558	189 216	23 276	191 334	20 934	186 500
BY USE						
I. Stone (Dimension)						
Dimension stone						
Rough	121	21 820	146	24 977	. .	. .
Monumental and ornamental stone (n.f.)	41	5 263	45	7 232	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	1	181	2	595	. .	. .
Total dimension stone	163	27 264	193	32 804	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	3 130	19 110	3 813	21 159	. .	. .
Asphalt aggregate	4 086	27 439	4 334	27 670	. .	. .
Road metal	6 102	32 139	4 594	25 717	. .	. .
Railroad ballast (includes traprock)	1 940	15 449	1 553	13 883	. .	. .
Other uses	6 828	37 205	7 586	40 932	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	4	247	1	60	. .	. .
Roofing granules	436	23 980	594	25 789	. .	. .
Poultry grit	1	104	1	93	. .	. .
Stucco dash	. . .	42	. . .	56	. .	. .
Rock wool	10	174	23	404	. .	. .
Rubble and riprap	648	5 402	299	1 798	. .	. .
Other uses	65	472	139	817	. .	. .
Pulverized stone						
Asphalt filler	128	106	128	62	. .	. .
Other uses	17	85	18	89	. .	. .
Total crushed stone	9 409	161 952	23 083	158 530	. .	. .
Total all stone	23 558	189 216	23 276	191 334	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; p Preliminary; x Confidential.
Notes: Numbers may not add to totals due to rounding. Data include shipments by producers regardless of industrial classification. Granite includes all igneous rock.

TABLE 6. CANADA, PRODUCTION OF SANDSTONE, 1998-2000

	1998		1999		2000p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE[1]						
Newfoundland	562	1 864	794	3 349	1 010	4 284
Nova Scotia	1 239	6 500	1 179	6 338	1 865	8 148
New Brunswick	. . .	46	. . .	x	1	x
Quebec	1 862	12 934	2 171	15 606	1 489	12 921
Ontario	10	1 577	14	2 287	21	2 340
Manitoba	1	1	1	x	. . .	x
Total	3 673	22 923	4 160	27 591	4 386	27 924
BY USE[2]						
I. Stone (Dimension)						
Dimension stone						
Rough	50	5 081	47	5 880	. .	. .
Monumental and ornamental stone (n.f.)	4	40	8	196	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	9	415	10	695	. .	. .
Total dimension stone	63	5 536	65	6 771	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	325	1 614	428	2 028	. .	. .
Asphalt aggregate	376	2 302	471	3 590	. .	. .
Road metal	1 218	5 366	1 441	6 614	. .	. .
Railroad ballast (includes traprock)	–	–	141	585	. .	. .
Other uses	1 464	6 999	1 298	6 414	. .	. .
Chemical process stone						
Cement plants, Canada	47	314	217	1 251	. .	. .
Other chemical uses	–	–	145	880		
Miscellaneous stone						
Manufacture of artificial stone	3	74	–	–	. .	. .
Rubble and riprap	44	94	110	432	. .	. .
Other uses	30	85	58	200	. .	. .
Pulverized stone						
Whiting	–	–	3	78		
Other uses	150	852	–	–	. .	. .
Total crushed stone	3 657	17 700	4 312	22 071	. .	. .
Total all stone	3 720	23 236	4 377	28 842	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; p Preliminary; x Confidential.
[1] Data exclude stone used in the Canadian cement industry. [2] Data include stone used in the Canadian cement industry.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, PRODUCTION OF SHALE,[1] 1998-2000

	1998		1999		2000[p]	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY[2]						
Newfoundland	109	1 188	6	24	8	38
Nova Scotia	25	112	24	x	23	x
New Brunswick	131	723	336	x	206	x
Quebec	753	7 205	671	x	224	x
Ontario	–	–	7	896	9	835
Manitoba	163	99	147	99	154	99
Alberta	47	1 260	16	x	16	x
British Columbia	34	510	76	464	70	441
Northwest Territories	205	4 056	10	x	49	x
Total	1 467	15 153	1 294	14 457	759	12 999
BY USE[3]						
I. Stone (Dimension)						
Dimension stone						
Rough	11	2 098	23	2 780	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	7	3 107	11	5 812	. .	. .
Total dimension stone	18	5 205	34	8 592	. .	. .
II. Stone (Crushed)						
Crushed stone for						
Concrete aggregate	–	–	–	–	. .	. .
Asphalt aggregate	94	645	–	–	. .	. .
Road metal	642	3 162	614	2 577	. .	. .
Other uses	571	5 872	510	2 863	. .	. .
Chemical and metallurgical						
Cement plants, Canada	233	695	529	1 781	. .	. .
Cement plants, foreign	–	–	59	264		
Other chemical uses	890	4 107	883	3 907	. .	. .
Miscellaneous stone						
Rubble and riprap	5	13	–	–	. .	. .
Other uses	137	256	77	162	. .	. .
Total crushed stone	2 572	14 749	2 673	11 552	. .	. .
Total all stone	2 590	19 954	2 707	20 144	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; [p] Preliminary; x Confidential.
[1] May include slate. [2] Data exclude stone used in the Canadian cement and clay industries. [3] Data include stone used in the Canadian cement and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 8. CANADA, PRODUCTION OF STONE BY TYPES,[1] 1985, 1990 AND 1998-2000

	1985		1990		1998		1999		2000[p]	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Granite	17 219	95 424	19 524	147 048	23 558	189 216	23 276	191 334	20 934	186 500
Limestone	77 874	317 862	86 519	470 649	79 058	456 951	79 165	475 758	84 960	518 430
Marble	571	13 966	771	19 555	1 168	43 704	1 288	66 358	1 309	76 072
Sandstone	3 011	15 310	2 975	20 534	3 673	22 923	4 160	27 591	4 386	27 924
Shale[2]	1 561	3 059	1 566	5 169	1 467	15 153	1 294	14 457	759	12 999
Total	100 236	445 622	111 355	663 254	108 924	727 947	109 184	775 499	112 348	821 926

Source: Natural Resources Canada.
[p] Preliminary.
[1] Data exclude stone used in the Canadian cement, lime and clay industries. [2] May include slate.
Note: Numbers may not add to totals due to rounding.

TABLE 9. CANADA, ROUGH GRANITE, SUMMARY OF PRODUCTION AND TRADE, 1980 AND 1985-2000

	Quantity / Value	Production[1]	Imports[2]	Exports[2]
1980	t	81 000	24 130	5 019[a]
	$ millions	5.6	1.9	0.7
1985	t	104 000	34 468	12 511[a]
	$ millions	12.8	6.2	1.7
1986	t	121 000	33 994	18 450[a]
	$ millions	15.7	6.6	2.7
1987	t	112 000	46 370	37 450[a]
	$ millions	16.1	7.9	6.0
1988	t	153 000	46 282	86 940
	$ millions	24.4	11.2	16.2[r]
1989	t	162 000	52 337	107 105
	$ millions	24.8	11.7	17.3
1990	t	166 000	46 149	79 640[r]
	$ millions	33.6	11.2	19.8[r]
1991	t	122 000	35 038	91 630[r]
	$ millions	24.0	8.5	22.6
1992	t	127 000	44 951	94 530[r]
	$ millions	20.3	10.5	21.4
1993	t	134 000	41 484	88 830[r]
	$ millions	18.1	10.8	20.3
1994	t	112 000	35 619	95 000[r]
	$ millions	16.9	10.1	20.0
1995	t	158 000	41 099	94 200[r]
	$ millions	19.6	11.4	17.9
1996	t	163 000	53 543	97 700[r]
	$ millions	24.6	15.4	20.9
1997	t	161 000	54 639	80 194[r]
	$ millions	24.5	16.0	16.4
1998	t	163 000	75 186	69 937
	$ millions	27.3	23.0	15.1
1999	t	193 000	68 770	73 685
	$ millions	32.8	23.2	16.5
2000	t	215 000[e]	65 979	95 680
	$ millions	35.0	21.8	19.4

Sources: Natural Resources Canada; Statistics Canada.
[e] Estimated; [r] Assumes a factor of 2.7 for converting cubic metres to tonnes.
[a] Coded as building stone, rough (90% is considered to be granite).
[1] Includes rough stone for construction, monumental/ornamental and other uses.
[2] Includes codes 2516.11 (roughly trimmed block) and 2516.12 (cut block by sawing or otherwise). Some re-exports to the United States may also be involved.

Sulphur

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Preliminary figures for 2000 show Canadian sulphur production was down by 1.3% when compared to the previous year's level. Total sulphur production was estimated at 9.8 Mt. Of this amount, elemental sulphur accounted for 8.0 Mt. Nearly all of this came from the production of natural gas, with the remainder derived from the refining of high-sulphur crude oil and heavy oil. An additional 1.1 Mt of sulphur, in the form of sulphuric acid and liquefied sulphur dioxide, was recovered from the smelting of metallic sulphides and the roasting of zinc sulphide concentrates. Most sulphur production occurs in Alberta, followed by British Columbia and Saskatchewan. Other provinces produce small amounts of sulphur, mostly from oil refining.

At an estimated 5.5 Mt, Canadian sulphur offshore exports[1] in 2000 were about 3.6% higher than in 1999. Losses in some destinations like Mexico, Morocco, India, Indonesia and Israel were more than compensated for by increased deliveries in Australia, Brazil, China and Senegal. Canadian sulphur was sold to about 20 countries.

In addition, Canada exported about 2.0 Mt of sulphuric acid, nearly all of it to the United States, as well as a small amount of sulphur dioxide, all of which went to the United States. Canadian sulphur imports continued to be minimal and were mostly from the United States.

Most elemental sulphur is used in the form of sulphuric acid, for which the single largest use is in the manufacture of phosphate-based fertilizers. An estimated 2.3 Mt of sulphuric acid were used in Canada in 1999 (a 6% decrease over 1998), the latest year for which statistics are available. About 43% of the acid used was for agricultural chemicals and fertilizers. The next largest use was for the pulp and paper industry, followed closely by industrial inorganic chemicals.

NEWS AND DEVELOPMENTS

Canada

In 2000, most if not all of the activity related to sulphur in Canada took place in the oil sands. As a result of this increased activity in the oil sands, and in light of sulphur's future strong importance regarding its contribution to Canada's oil industry, the National Energy Board issued a report entitled *Canada's Oil Sands: A Supply and Market Outlook to 2015*. This report provides a good summary of the current situation and future possible developments. One of the main conclusions of the report is that, by 2015, more than 50% of Canada's crude oil production will come from the oil sands. Since oil sands contain between 5% and 7% of sulphur, the oil sands industry is also expected to be a major contributor to Canadian production of sulphur in the future. The current elemental sulphur production could be increased by up to 2 Mt yearly by 2015. In all, nearly 60 projects valued at $34 billion are planned for the period 1996-2010, some of which are described below.

In August 2000, Syncrude Canada Ltd., the largest Canadian source of crude oil and the world's largest oil sands producer, announced the official opening of its Aurora mine as part of its Syncrude 21 Program. It is located 35 km north of the Mildred Lake site and is the first remote mine/extraction facility in the oil sands industry. The new technology developed by Syncrude researchers and engineers will improve both production efficiency and environmental performance. In 2000, total capital investment in the Syncrude 21 Program was $510 million. In 2001, about $900 million will be spent. By the end of the project in 2007, $8 billion will have been spent. The Syncrude project is a joint venture operated by Syncrude Canada Ltd. and owned by AEC Oil Sands, L.P., AEC Oil Sands Limited Partnership, Athabasca Oil Sands Investments Inc., Canadian Occidental Petroleum Ltd., Canadian Oil Sands Investments Inc.,

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[1] The trade numbers used are from industry, which differ from Statistics Canada's numbers.

Gulf Canada Resources Limited, Imperial Oil Resources Limited, Mocal Energy Limited, Murphy Oil Company Ltd., and Petro-Canada. Syncrude also pursued its underground storage trials with Alberta Sulphur Research Ltd. (refer to the 1999 Sulphur chapter for further details).

Work continued on the $2.8 billion second phase of Suncor Energy Inc.'s Project Millennium, which is designed to increase oil sands production capacity to 225 000 barrels per day by 2002. In January 2000, the company announced its plans to invest $750 million to add a commercial-scale in-situ plant at its Firebag lease and bolster its upgrading capacity with an upgrader expansion. This upgrading expansion will allow production of approximately 260 000 barrels of oil per day in 2004 and result in the doubling of Suncor's current sulphur production to about 220 000 t/y.

Work at the Athabasca Oil Sands Project has started. This project is a partnership between Shell Canada Limited (60%), Chevron Canada Resources Limited (20%) and Western Oil Sands Inc. (20%). The project includes $1.8 billion for the development of the Muskeg River mine located 75 km north of Fort McMurray, Alberta, and is expected to begin production in 2002. In addition, the project requires $1.7 billion for the Scotford Upgrader located beside Shell's Scotford refinery north of Fort Saskatchewan, Alberta. When the project is completed by 2004, it will add about 450 000 t of sulphur to Canadian production on an annual basis. The project is expected to have a 30-year life.

In September, Petro-Canada announced a $290 million plan to develop its MacKay River oil sand property, with production expected to start in late 2002. The company is also looking at the possibility of building an upgrader at its Edmonton refinery. This upgrader could produce an estimated 600 t/d of sulphur.

In November, Canadian Natural Resources Limited (CNRL) announced its $6.5 billion plan to develop, by the end of the decade, its Mic Mac project 70 km north of Fort McMurray, Alberta. CNRL acquired the lease for Mic Mac from BP Canada in 1999.

TrueNorth Energy (formerly Koch Petroleum Canada Ltd.) continued its exploratory program at Fort Hills, 90 km north of Fort McMurray, where it plans to build a $2 billion mine, processing facility and on-site utilities and infrastructure.

The opening of two new uranium mines in Saskatchewan is likely to result in increased use of sulphur. The MacArthur River mine is operated by Cameco Corporation and the ore will be processed at the Key Lake plant. The McClean Lake mine is operated by COGEMA Resources Inc. and will have new milling facilities along with a new sulphuric acid plant, which will replace Cameco's Rabbit Lake plant. Another project is also being developed at Cigar Lake. Any production from Cigar Lake will be processed at McClean Lake.

Marsulex Inc. has signed two 10-year contracts with Petro-Canada and Shell Canada for their Montréal refineries.

United States

The biggest news out of the United States is without a doubt the closure of the Main Pass Frasch sulphur mine on August 31, 2000. The closure of the mine by McMoRan Exploration happened almost six months ahead of schedule and was due to reduced demand, low prices and increased production costs. The mine was operated by Freeport Sulphur. It was the only remaining Frasch sulphur operation in the United States after the closure of the Culberson mine in 1999. The Main Pass 299 deposit was discovered in 1989 and started production in late 1991. It had its best production years in the mid-1990s with an average yearly production of about 2 Mt. Sulphur production in the United States now comes entirely from petroleum refineries, natural gas-processing plants and coking plants.

PRICES

Entering 2000, sulphur price quotations on a free on board (f.o.b.) Vancouver basis were between US$35 and $39/t. Quotations quickly reached a plateau of US$40-$42/t in February and then remained at that level until June when they started to show some weakness. By the end of 2000, they had decreased to US$30-$36/t. This decrease was largely due to increased competition from sulphur producers in the Middle East in some of Canada's traditional markets.

USES

The principal use of all sulphur consumed in the world is as a process agent in the manufacture of fertilizers such as superphosphates, ammonium phosphate and ammonium sulphate (60% of world demand). The second-largest consuming sector is the chemical industry where sulphur is used as sulphuric acid in products ranging from pharmaceuticals to synthetic fibres. Other consumers of sulphur include manufacturers of pulp and paper, iron and steel, nonferrous metals, and titanium dioxide pigments. These consuming industries use sulphur in the form of sulphuric acid, which accounts for almost 90% of total sulphur use. (Some 60% of sulphuric acid use is in fertilizers.) Manufactured products that require sulphur in non-acid form in their production include insecticides and fungicides, pulp and paper, photography, leather products, rayon and rubber.

OUTLOOK

In 2001, the world sulphur market is expected to perform at a level equal to or slightly better than that of 2000. Exports of Canadian sulphur to China are expected to continue to grow, but at a much slower rate than in 2000, which saw a 25% increase over 1999. This is due largely to the desire of Chinese users to diversify their supply sources as they move away from the pyrite process. In the coming years, Canadian producers can expect further competition from the former Soviet Union, Iran and Saudi Arabia.

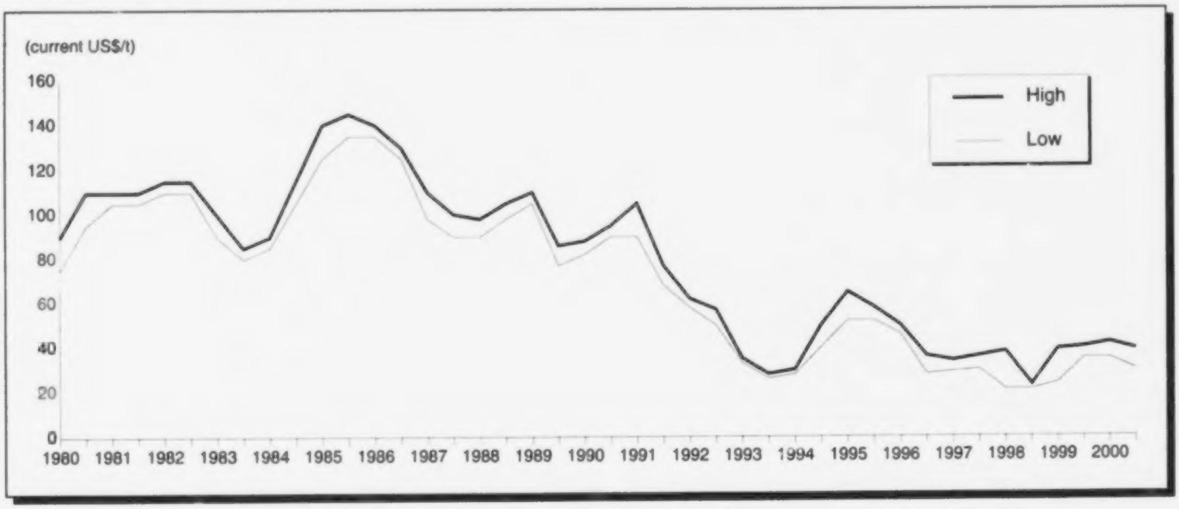
In 2000, Canadian sulphur production is expected to remain at its 1999 level or to be up marginally. Prices are expected to continue to decrease and stabilize around the US$20/t level.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of March 31, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 1
Canada, Offshore Sulphur Price Quotations, 1980-2000
f.o.b. Vancouver Contract



Source: Compiled by Natural Resources Canada from trade magazines and specialized subscriptions.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2503.00.00	Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur				
2503.00.00.10	Crude or unrefined sulphur	Free	Free	Free	Free
2503.00.00.90	Other	Free	Free	Free	Free
2802.00.00	Sulphur, sublimed or precipitated; colloidal sulphur	Free	Free	Free	Free
2807.00.00	Sulphuric acid; oleum	Free	Free	Free	Free
2811.23.00	Sulphur dioxide	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001.

TABLE 1. CANADA, SULPHUR SHIPMENTS AND TRADE, 1999 AND 2000

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	Sulphur in smelter gases[2]	1 072 577	73 616	1 140 499	73 261
	Elemental sulphur[3]	8 143 976	93 776	7 996 263	94 922
	Total sulphur content	9 216 553	167 392	9 136 762	168 183
PRODUCTION[1]					
	Sulphur in smelter gases[2]	1 159 812	. .	1 159 162	. .
	Elemental sulphur[3]	8 812 609	. .	8 679 770	. .
	Total sulphur content[2]	9 972 421	. .	9 838 932	
EXPORTS					
2503.00.00.10	Sulphur, crude or unrefined				
	China	1 287 299	63 642	1 455 744	84 387
	Brazil	661 455	38 216	789 842	53 665
	South Africa	546 536	27 827	367 880	22 411
	Mexico	469 885	23 786	378 769	21 015
	Cuba	154 692	14 902	181 663	18 608
	United States	370 399	16 628	445 146	16 336
	Australia	175 925	8 594	281 706	16 058
	Morocco	608 668	35 883	231 838	13 673
	New Zealand	144 878	7 339	149 350	8 655
	Israel	354 656	13 370	165 250	8 590
	Senegal	37 672	3 180	97 768	7 398
	Indonesia	89 019	5 668	72 750	5 223
	Philippines	70 686	3 016	89 308	4 688
	Chile	32 000	2 967	64 061	2 845
	Argentina	–	–	24 473	1 802
	Guatemala	2 608	138	6 150	361
	Spain	–	–	4 000	228
	Salvador	2 200	117	3 850	223
	Costa Rica	–	–	1 000	58
	Tunisia	26 251	1 082	–	–
	Japan	15 000	574	–	–
	Total	5 049 829	266 929	4 810 548	286 224
2503.00.00.90	Sulphur, n.e.s.				
	United States	48 219	4 770	30 942	2 668
	China	–	–	1	. . .
	South Africa	4 665	168	–	–
	Total	52 884	4 938	30 943	2 668

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
2802.00	Sulphur, sublimed or precipitated; colloidal sulphur				
	Ireland	–	–	3	10
	United States	20	10	88	7
	Mexico	20	37	–	–
	Total	40	47	91	17
2807.00	Sulphuric acid; oleum				
	United States	865 270	35 127	808 104	31 141
	Mexico	29 372	740	63 800	1 443
	Chile	–	–	37 754	1 142
	Hong Kong	–	–	131	20
	Norway	–	–	183	17
	Iceland	–	–	9	14
	Saint Lucia	–	–	3	13
	Italy	–	–	70	9
	Cuba	–	–	1	. . .
	Croatia	122	18	–	–
	Lebanon	79	10	–	–
	Sudan	1	15	–	–
	China	14	151	–	–
	Total	894 858	36 061	910 055	33 799
2811.23	Sulphur dioxide				
	United States	50 101	13 020	46 087	11 639
	Chile	1	1	–	–
	Total	50 102	13 021	46 087	11 639
IMPORTS					
2503.00.00.10	Sulphur, crude or unrefined				
	United States	19 673	2 842	18 641	2 724
	South Africa	–	–	1	. . .
	Total	19 673	2 842	18 642	2 724
2503.00.00.90	Sulphur, n.e.s.				
	United States	29 134	4 675	28 568	4 990
	Finland	566	97	172	32
	France	294	47	101	24
	Germany	24	4	235	20
	China	57	16	63	19
	South Korea	–	–	315	13
	Japan	4	. . .	2	. . .
	South Africa	1	. . .	1	. . .
	Malaysia	2	. . .	–	–
	Uruguay	3	1	–	–
	United Kingdom	1	. . .	–	–
	Total	30 086	4 840	29 457	5 098
2802.00	Sulphur sublimed or precipitated; colloidal sulphur				
	United States	170	117	518	280
	France	431	230	190	132
	United Kingdom	. . .	. . .	59	48
	Germany	5	2	31	21
	China	–	–	6	2
	Japan	1	. . .	1	1
	Indonesia	–	–	4	1
	Netherlands	4	2	3	. . .
	Total	611	351	812	485

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
2807.00	Sulphuric acid; oleum				
	United States	138 081	10 037	157 538	11 232
	India	127	9	488	40
	United Kingdom	14	1	71	5
	Germany	13	1	35	3
	Canada	126	15	4	. . .
	Spain	–	–	2	. . .
	Sweden	1	. . .	1	. . .
	Switzerland	. . .	. . .	2	. . .
	South Africa	–	–	2	. . .
	Netherlands	50	2	2	. . .
	Taiwan	–	–	2	. . .
	Belgium	3	. . .	–	–
	Italy	2	. . .	–	–
	China	377	38	–	–
	Japan	6	1	–	–
	Mexico	7	1	–	–
	Total	138 807	10 105	158 147	11 280
2811.23	Sulphur dioxide				
	United States	2 659	436	7 441	1 365
	Germany	6	1	9	2
	Canada	171	23	–	–
	Total	2 836	460	7 450	1 367

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.

[1] Data compiled regardless of origin (i.e., domestic and foreign source materials). [2] Sulphur in liquefied SO_2 and H_2SO_4 recovered from the smelting of metallic sulphides and from the roasting of zinc sulphide concentrates. [3] Producers' shipments of elemental sulphur produced from natural gas; also included are small quantities of sulphur produced in the refining of domestic crude oil and synthetic crude oil.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, SULPHUR SHIPMENTS AND TRADE, 1983-2000

	Shipments[1]			Imports[2]	Exports[2]
	In Smelter Gases	Elemental Sulphur	Total	Elemental Sulphur	Elemental Sulphur
			(tonnes)		
1983	678 286	6 631 123	7 309 409	2 365	5 670 275
1984	844 276	8 352 978	9 197 254	3 019	7 326 847
1985	822 359	8 102 163	8 924 522	3 167	7 848 380
1986	758 141	6 953 298	7 711 439	10 763	6 257 054
1987	783 115	7 322 791	8 105 906	24 711	6 571 800
1988	867 800	8 106 641	8 974 441	21 825	7 384 160
1989	831 503	6 868 930	7 700 433	18 311	5 514 059
1990	879 149	6 873 495	7 752 644	13 203	6 057 523
1991	883 565	6 937 884	7 821 449	9 026	5 845 372
1992	914 978	6 393 932	7 308 910	8 645	5 653 506
1993	856 236	5 220 304	6 076 540	7 532	4 193 877
1994	1 025 561	5 791 482	6 817 043	1 979	4 983 257
1995	1 074 206	7 089 297	8 163 503	25 593	6 077 414
1996	1 033 348	7 433 112	8 466 460	24 345	6 026 287
1997	1 060 743	7 900 926	8 961 669	46 370	6 497 753
1998	1 048 169	7 406 276	8 454 445	53 123	5 253 364
1999	1 072 577	8 143 976	9 216 553	49 759	5 102 713
2000p	1 140 499	7 996 263	9 136 762	48 099	4 841 491

Sources: Natural Resources Canada; Statistics Canada.

p Preliminary.

[1] Shipment data compiled regardless of origin (i.e., domestic and foreign source materials). [2] Includes only elemental sulphur in a crude or refined form.

TABLE 3. CANADA, SULPHURIC ACID PRODUCTION, TRADE AND APPARENT USE, 1986-2000[p]

	Production	Imports	Exports	Apparent Use
	(tonnes, 100% acid)			
1986	3 536 062	29 127	755 606	2 809 583
1987	3 436 977	44 623	803 178	2 678 422
1988	3 804 856	40 078	851 622	2 993 312
1989	3 718 578	28 433	978 190	2 768 821
1990	3 829 570	71319	1 280 502	2 620 387
1991	3 675 839	79 207	1 265 740	2 489 306
1992	3 776 086	86 284	1 340 213	2 522 157
1993	3 958 416	95 806	1 629 054	2 425 168
1994	4 055 165	68 261	1 645 406	2 478 020
1995	4 276 383	70 816	1 732 522	2 614 677
1996	4 355 592	76 016	1 596 343	2 835 265
1997	4 314 773	95 551	1 602 468	2 807 856
1998	4 611 311	129 201	1 581 604	3 158 908
1999	4 282 151	138 807	894 858	3 526 100
2000[p]	. .	158 147	910 055	. .

Sources: Natursal Resources Canada; Statistics Canada.
. . Not available; [p] Preliminary.

TABLE 4. CANADA, SULPHURIC ACID, REPORTED USE BY END USE, 1997-99

End Use	1997[a]	1998[a]	1999[p,a]
		(tonnes)	
Agricultural chemicals and fertilizers	1 164 570	1 186 560	1 021 928
Pulp and paper	490 822	480 082	522 359
Industrial inorganic chemicals	459 483	498 981	489 816
Nonferrous smelting and refining	116 502	123 416	119 016
Uranium mines	102 159	90 031	57 988
Crude and refined petroleum products	54 445	32 041	31 588
Soap and cleaning compounds	x	x	x
Other mines, metal and nonmetal	30 160	17 442	13 834
Metal rolling and extruding	9 120	8 770	11 940
Electrical products	3 577	4 131	4 237
Food, brewery and distillery	x	2 286	2 890
Plastics and synthetic resins	x	x	x
Leather and textile	–	x	x
Other end uses	35 794	38 664	49 464
Total[1]	2 485 013	2 497 166	2 341 727

Source: Reports from producing companies, compiled by Natural Resources Canada, 2001.
– Nil; [p] Preliminary; x Confidential.
[a] Confidential numbers are included in the totals.
[1] Reported use does not include imported acid.
Note: Numbers may not add to totals due to rounding.

TABLE 5. WORLD PRODUCTION OF SULPHUR, 1997-99

	1997[r]		1998[r]		1999[p]	
	All Forms[1]	Elemental	All Forms[1]	Elemental	All Forms[1]	Elemental
			(000 tonnes)			
WESTERN EUROPE						
Finland	728	40	768	50	806	60
France	1 200	945	1 099	849	1 051	790
Germany	2 443	1 623	2 620	1 761	2 690	1 823
Italy	527	354	557	393	569	436
Netherlands	475	364	539	418	580	453
Spain	1 106	175	1 069	190	1 013	205
Others	1 237	741	1 249	762	1 135	651
Total, Western Europe	7 716	4 242	7 901	4 423	7 844	4 418
CENTRAL EUROPE						
Poland	1 974	1 710	1 559	1 290	1 425	1 145
Others	604	195	647	210	485	220
Total, Central Europe	2 578	1 905	2 206	1 500	1 910	1 365
FORMER SOVIET UNION	5 765	4 465	6 993	5 678	7 885	6 482
AFRICA						
South Africa	503	231	489	227	472	221
Others	148	5	118	5	86	10
Total, Africa	651	236	607	232	558	231
NORTH AMERICA						
Canada	9 481	8 408	9 694	8 541	9 972	8 813
United States	13 125	10 460	12 813	10 070	12 458	10 000
Total, North America	22 606	18 868	22 507	18 611	22 430	18 813
LATIN AMERICA						
Mexico	1 392	923	1 393	912	1 368	856
Others	1 694	567	1 997	692	2 334	763
Total, Latin America	3 086	1 490	3 390	1 604	3 702	1 619
MIDDLE EAST						
Iran	845	815	861	861	895	895
Iraq	425	425	475	475	575	575
Kuwait	591	591	650	650	639	639
Saudi Arabia	1 690	1 701	1 880	1 880	1 940	1 940
Unitd Arab Emirates	900	900	980	980	1 090	1 090
Others	399	255	489	336	527	394
Total, Middle East	4 850	4 687	5 335	5 182	5 666	5 533
ASIA						
China	7 810	230	7 041	228	6 612	370
Japan	3 457	2 013	3 514	2 083	3 592	2 059
South Korea	952	617	1 143	669	1 194	670
Others	1 250	663	1 433	812	1 728	702
Total, Asia	13 469	3 523	13 131	3 792	13 126	3 801
OCEANIA	444	60	449	50	476	49
Total, World	61 165	39 476	62 519	41 072	63 597	42 311

Source: British Sulphur Consultants, 2000.

[p] Preliminary; [r] Revised.

[1] All forms includes elemental sulphur, sulphur contained in pyrites, and contained sulphur recovered from metallurgical waste gases, mostly in the form of sulphuric acid.

Uranium

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OVERVIEW

In 2000, the liquidation of uranium inventories by a limited number of companies continued, placing downward pressure on the uranium market. Activity in the spot market was minimal and spot prices drifted continuously lower during the year. It was not until the Bush administration took office in January 2001, brightening prospects for further nuclear power development in the United States, that spot prices slowly began to rise.

In addition to inventory disposition and the marketing of uranium derived from dismantling Russian nuclear weapons, primary producers faced continued competition from uranium produced by the re-enrichment of depleted uranium tailings. However, Canadian uranium producers remain well positioned to capitalize on any market upturn as the transition to new production centres tapping high-grade, low-cost deposits in northern Saskatchewan is well under way.

Canadian uranium production in 2000 amounted to 10 683 tU, up some 30% from the 1999 total, mainly due to contributions from the new McClean Lake and McArthur River mines. As Figure 1 shows, the world's two largest uranium-producing companies have operations in Canada. As of January 1, 2001, Canada's total "known" recoverable uranium resources were 437 000 tU, compared with 417 000 tU as of January 1, 2000. This upward adjustment of some 5% is primarily the result of increased McArthur River resources.

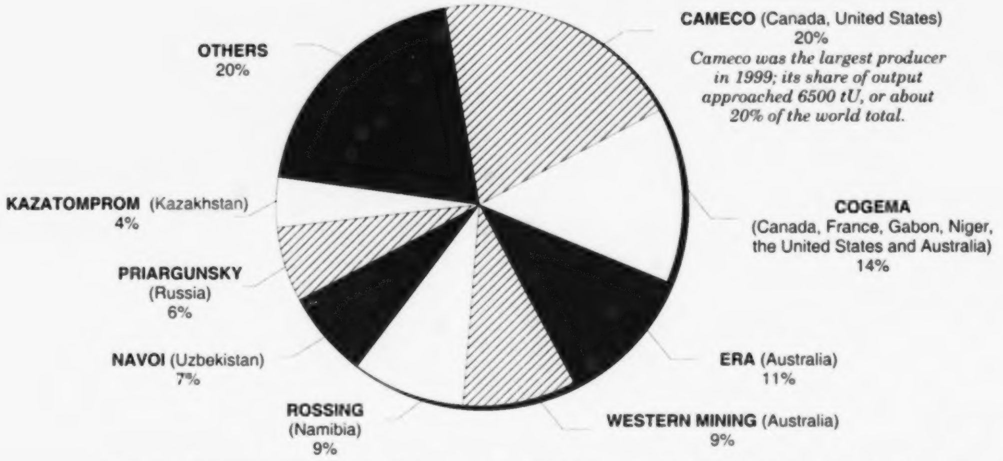
Despite low prices, Canadian uranium production capability continues to expand in the province of Saskatchewan. The McClean Lake mill, which entered into production in June 1999, reached its annual licensed production capacity of 2300 tU in November 2000. The McArthur River mine, which entered into production in December 1999, continued to ramp up towards its annual licensed production capacity of 6900 tU, producing about 3740 tU in 2000. Test mining and development continued at Cigar Lake in 2000 with the mine currently expected to begin production in 2005.

DOMESTIC PRODUCTION AND DEVELOPMENTS

In 1999, the most recent year with complete data available, production amounted to 8214 tU, a sharp drop from 1998 and 1997, mainly due to planned production cutbacks. Nonetheless, overall employment at Canada's uranium production centres remained above 1000 (Table 1). Shipments from mining centres increased slightly in 1999, compared to 1998, although the value of these mine shipments remained about the same (Table 2). These variations primarily reflect planned production cutbacks, the transition to new high-grade uranium mines, and the low market price. Despite these conditions, however, uranium continues to rank among Canada's top 10 metal commodities in terms of output value. Table 3 documents the main operational characteristics of the existing uranium production centres in Canada in 1999, and Table 4 updates the status of new projects that represent Canada's future production capability. Although current production and new projects are centred in the Athabasca basin of northern Saskatchewan, one prospective property, Kiggavik, is located in Nunavut (Figure 2). Uranium production in Canada in 1999 (Figure 3) was dominated by two companies: Cameco Corporation and COGEMA Resources Inc. (CRI).

On August 25, 2000, Billiton Plc and Rio Algom Limited announced that they had reached an agreement whereby Billiton would offer $27.00 per share to acquire the entire issued share capital of Rio Algom (a total of some $1.7 billion). Rio Algom recommended that shareholders accept this offer on September 15, 2000, and by November 29, 2000, Billiton had completed the acquisition of the balance of the common shares, finalizing the Rio Algom purchase. Headquartered in London, Billiton is one of

Figure 1
World's Top Uranium Mining Companies in 1999



Cameco was the largest producer in 1999; its share of output approached 6500 tU, or about 20% of the world total.

These eight companies accounted for about 80% of 1999 world production, which totaled some 31 000 tU.

Sources: Natural Resources Canada; trade press.
Note: Ranking reflects equity interest in production facilities, not market share.

the world's largest mining and metals companies with major operations and development projects concentrated in three main mining areas of Australia, Latin America and southern Africa.

In March 2001, Redstone Resources Inc. purchased a 20.7% share in the Midwest Uranium Project as both Denison Mines Limited and CRI reduced their interests by 5.04% and 15.66%, respectively. The new Midwest ownership structure is documented in Table 4.

Elliot Lake, Ontario

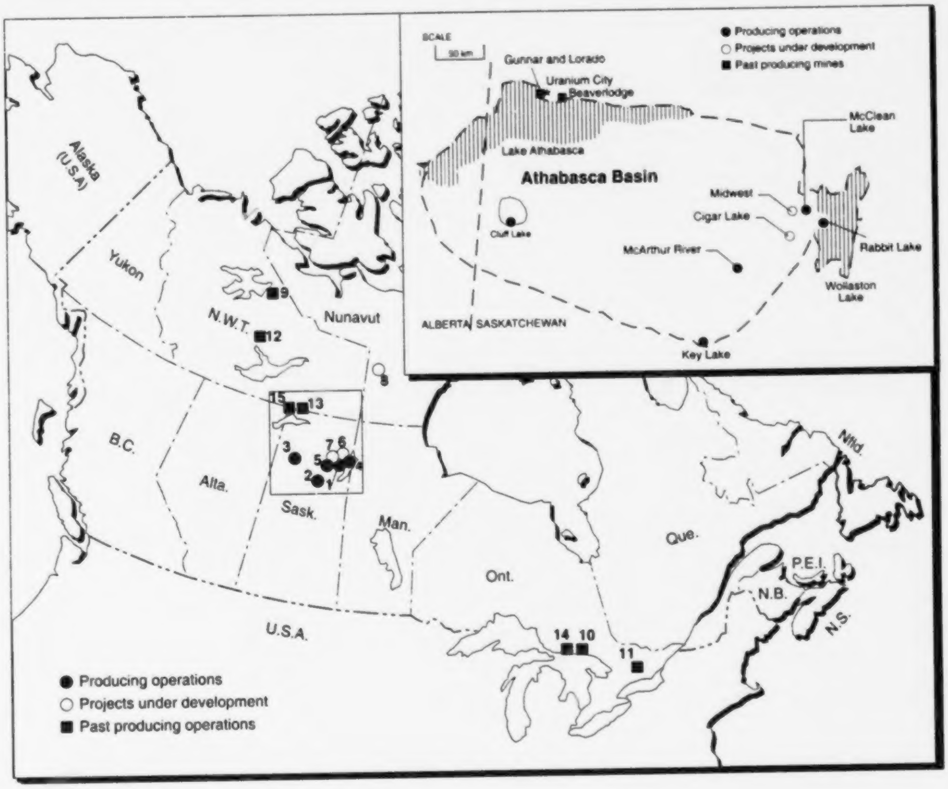
All significant reclamation work at Denison Mines' Elliot Lake properties was completed in 1998. Dension continues to be in full compliance with all of its licence requirements for the tailings management areas, and all systems at the former mine sites are operating better than anticipated. Monitoring the tailings management areas at the Denison and Stanrock sites and the treatment of water discharged from these areas are ongoing. In 2000, additional activities at the two sites included treatment of runoff, surface drainage alteration, and the use of bio-solids to improve the vegetation cover on the Stanrock tailings basin.

Denison, in cooperation with Rio Algom, began reporting water quality data in January 2000 for the Serpent River Watershed Monitoring Program (SRWMP), a comprehensive effort to provide data to assess the recovery of the watershed, which hosted uranium mining for over 40 years. Initial results indicate that water quality in the Serpent River, which drains the Elliot Lake watershed into Lake Huron, continues to improve, confirming that water in the river meets drinking water guidelines and provides a healthy habitat for fish.

Prior to Billiton's acquisition, Rio Algom and its predecessor companies operated nine uranium mines in Elliot Lake, which was Canada's major uranium-producing area for over four decades. Since 1985, Rio Algom has dismantled and remediated uranium mine sites in the region. In reclaiming the Quirke and Panel tailing areas, the primary environmental issues were preventing or controlling the long-term production of acid rock drainage and the contamination of water by radioactive materials. Rio Algom's proposal to cover these tailings with water was accepted and supported by a public review panel and approved by governments and regulators.

Dams and dikes were built to create ponds to submerge the tailings. Since the material is no longer exposed to air, the formation of acid generated in the waste rock is limited. The water also acts as a barrier to radiation releases. Water flowing from the site is being treated and will continue to be treated until water quality meets discharge criteria without treatment. At that time, the sites will enter into a phase of long-term monitoring with care and maintenance.

Figure 2
Uranium Mining in Canada, 2000


SCALE
50 km
Gunnar and Lorado
Uranium City
Beaverlodge
● Producing operations
○ Projects under development
■ Past producing mines
Lake Athabasca
Athabasca Basin
McClean Lake
Midwest
Cigar Lake
Cliff Lake
McArthur River
Rabbit Lake
Wollaston Lake
ALBERTA
SASKATCHEWAN
Key Lake
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
● Producing operations
○ Projects under development
■ Past producing operations

Numbers refer to locations on map above

PRODUCING OPERATIONS

1. Rabbit Lake
2. Key Lake
3. Cluff Lake
4. McClean Lake
5. McArthur River

PROJECTS UNDER DEVELOPMENT

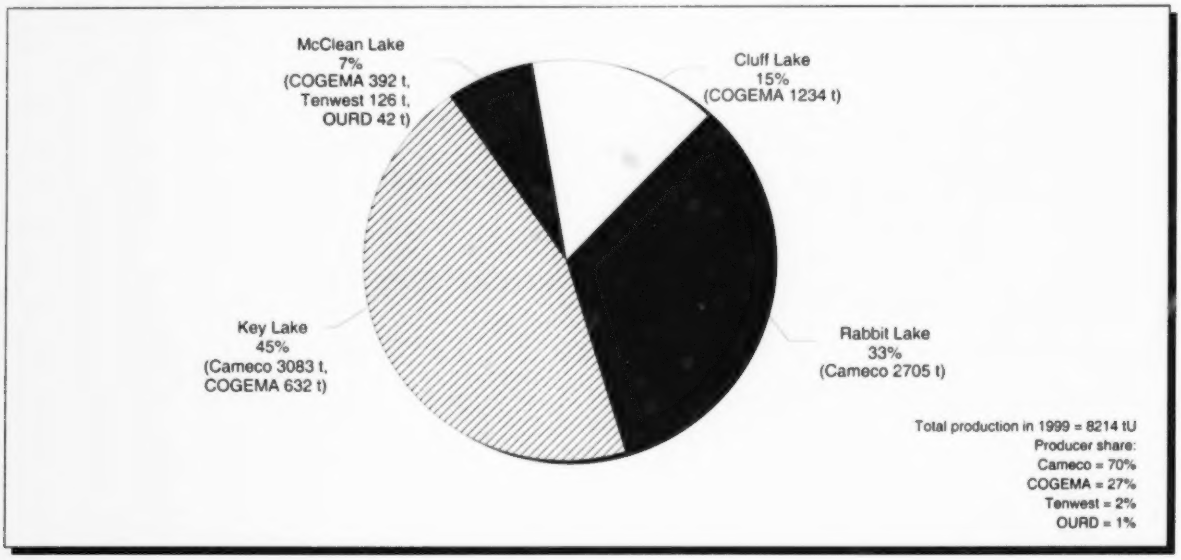
6. Midwest
7. Cigar Lake
8. Kiggavik

PAST PRODUCING DEVELOPMENT

9. Port Radium
10. Agnew Lake
11. Madawaska et al (Bancroft)
12. Rayrock (Marian River)
13. Beaverlodge et al
14. Quirke/Panel/Denison and Stanleigh et al (Elliot Lake)
15. Gunnar and Lorado et al

Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

Figure 3
Canadian Uranium Production and Ownership, 1999



Sources: Uranium and Radioactive Waste Division, Natural Resources Canada.
Cameco: Cameco Corporation; COGEMA: COGEMA Resources Inc.; OURD: OURD (Canada) Co. Ltd.; Tenwest: Tenwest Uranium Ltd.
Note: Tenwest is a wholly owned subsidiary of Denison Mines Limited.

Since the local topography around some of the older sites does not allow for the safe flooding of tailings, these areas have been vegetated to control dust and surface run-off. Run-off and seepage from the sites are collected for treatment. Of these older sites, Rio Algom's Spanish American, Milliken, Lacnor, Nordic, Buckles and Pronto uranium mining sites are not presently licensed by the Canadian Nuclear Safety Commission (CNSC). Although uranium mining and milling ceased at these facilities over 30 years ago, Rio Algom is currently in the process of obtaining CNSC licences for these sites.

Athabasca Basin, Saskatchewan

Rabbit Lake

The Rabbit Lake uranium production facility is wholly owned and operated by Cameco. Mill output in 2000 was similar to 1999 production (about 2790 tU), equivalent to about 50% of the facility's licensed production capacity. The decision to run the mill at reduced capacity was one part of Cameco's 1998 planned production cutbacks.

Cameco's planned production cutbacks also included the suspension of mining operations at the Rabbit Lake Eagle Point underground mine on March 31, 1999. In August 2000, Cameco decided to extend the temporary suspension of mining activities at Rabbit Lake. As a result, when the existing ore stockpile is depleted (expected in June 2001), the mill will be placed on standby for approximately one year, depending on market conditions. Cameco has re-evaluated the Eagle Point mining plan to achieve further efficiencies and will seek regulatory approval in 2001 to re-open the facility based on the revised mining plan.

Key Lake

The Key Lake mill is a joint venture between Cameco and CRI that is operated by Cameco. In 2000, Key Lake production amounted to 4142 tU, up from the 1999 total of 3715 tU. All but 402 tU of the Key Lake production in 2000 is derived from McArthur River ore. The small contribution from Key Lake ore is derived from stockpiled low-grade mineralized waste rock; it is used to lower the McArthur River ore grade to about 3.4% U before being run through the mill circuit.

McArthur River

The McArthur River mine, the site of the world's largest high-grade uranium deposit discovered to date, is a joint venture between Cameco and CRI that is operated by Cameco. Mining began at McArthur River in December 1999 and, by November 2000, commercial production was achieved. The McArthur River mine is expected to achieve its monthly design capacity of 577 tU consistently through 2001.

In January 2001 it was announced that, as a result of an extensive underground drilling program, McArthur River's total reserves and resources had been increased by more than 50%. The McArthur River mine now has total reserves and resources amounting to some 152 000 tU with an average grade of 18% U (from the previous total of 98 000 tU at an average grade of 15% U).

Cluff Lake

The Cluff Lake uranium production facility is fully owned and operated by CRI. The mill operated throughout 2000 on a one-week-on/one-week-off schedule (excluding a three-week shut-down in July). Overall production amounted to 1443 tU in 2000, up from the 1234 tU produced in 1999, mainly due to mining higher ore grades. Mining is ongoing at the Dominique-Janine underground mine and is expected to continue throughout 2001. It is anticipated that the mill will continue operating in 2002 until all stockpiled ore is processed.

CRI had announced in 1998 its intention to suspend operations indefinitely at Cluff Lake on December 31, 2000. However, allowable capacity remaining in the tailings management area (TMA), higher ore grades, lower production costs and improved productivity have enabled operations to continue. Although higher-than-expected ore grades have resulted in fewer tailings, production remains limited by the capacity of the TMA. Because of the significant capital expense required to build a new TMA, CRI's decision to suspend operations at Cluff Lake has not changed.

In anticipation of the suspension of operations, CRI has begun site clean-up and reclamation activities, including removal of ore storage bins, the gold plant, buildings at the Claude pit, the mine water holding pond, and the remaining reusable equipment from the Dominique-Peter underground mine. CRI has also implemented an outplacement program to assist employees affected by the upcoming suspension of operations.

McClean Lake

The McClean Lake uranium production facility is majority-owned and operated by CRI. In 2000, production reached its licensed capacity (2308 tU) by the end of October. In its 2001 licence renewal application to the CNSC, CRI has requested that McClean Lake's annual production capacity be increased by an additional 769 tU. A decision on the McClean Lake licence renewal is expected in August 2001.

During 2000, the McClean Lake mill was fed by ore from the Sue C open pit and stockpiled ore from the JEB open pit. Ore from the Sue C mine is expected to provide mill feed for some 12-18 months.

Following two years of preparation, the McClean Lake operation received ISO 14001 certification for its environmental management system – the first uranium mine in North America to do so.

Cigar Lake

The Cigar Lake mine is a joint venture being developed by the Cigar Lake Mining Corporation (Table 4). The Cigar Lake orebody is the world's second largest high-grade uranium deposit discovered to date. At present, the site consists of an underground development mine complete with two main levels and a 500-m mine shaft and head frame, water treatment ponds, standby generators, a freeze plant and support installations. Cigar Lake is not expected to enter into production until 2005.

Additional Production Possibilities

Beyond the existing and committed centres of uranium production mentioned above, there are two projects that could be brought on stream in the next few years if environmental and regulatory approvals are received and market conditions are favourable. Table 4 updates, as of June 1, 2001, recent developments at the mining projects that will contribute to Canada's uranium production capability in the future.

Environmental Assessments

As mentioned above, Rio Algom decided in 1995 to license historic mines in the Elliot Lake region (Spanish American, Milliken, Lacnor, Nordic, Buckles and Pronto) that are not presently licensed by the CNSC. In support of its licence application, Rio Algom has submitted an environmental assessment screening report to the CNSC. Review and revision of this report are ongoing with licensing anticipated in 2001.

CRI is currently preparing a comprehensive study (CS) environmental assessment under the *Canadian Environmental Assessment Act* of its plans to suspend operations at Cluff Lake. Early in 2001, the CS, which outlines, among other issues, the decommissioning plan, options and mitigation measures, was submitted to the CNSC for preliminary review. Development of this CS has already involved public consultation and additional public consultations on the CS and the decommissioning plan are scheduled to take place once the assessment is finalized.

In its 2001 operating licence application renewal to the CNSC, CRI has requested that the McClean Lake annual production capacity be increased by some 769 tU (to 3077 tU). The requested amendment requires a screening report environmental assessment that is expected to be completed before the initial CNSC hearing on the McClean Lake licence scheduled for June 28, 2001.

In late 2000, CRI and Cigar Lake Mining Corporation submitted a screening report environmental assessment of the preferred options to dispose of potentially acid-generating waste rock from the Cigar Lake mine. The proponents determined that the preferred option is disposal in the mined-out Sue C pit at McClean Lake. The report is now under review by regulatory agencies.

A CS environmental assessment of the proposal to mill approximately half of the Cigar Lake ore at the Rabbit Lake mill is expected to be submitted to regulators in 2001. Subject to regulatory approvals and mutually agreeable business arrangements among the joint-venture partners, ore from Cigar Lake could feed the Rabbit Lake mill for some 10-14 years.

Other Developments Affecting Canada's Uranium Industry

In October 2000, Cameco Corporation announced that it had signed an agreement with British Energy plc to acquire a 15% interest in the Bruce Power Partnership (Bruce Power). Under the terms of the agreement, Cameco will have full responsibility for managing all of Bruce Power's fuel procurement needs. The agreement came into effect on May 12, 2001, shortly after the Bruce Power Partnership received an operating licence from the CNSC. The Bruce nuclear power plants consist of four Bruce B reactors currently in operation and four Bruce A reactors that are not operating. Bruce Power plans to bring two of the Bruce A reactors back into operation by the summer of 2003, subject to regulatory approvals.

EXPLORATION

Natural Resources Canada (NRCan) completed its twenty-fifth annual assessment of Canada's uranium supply capabilities and uranium exploration, and reported[2] the results in September 2000. Uranium exploration activity remains concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, notably in the Athabasca Basin of Saskatchewan and the Thelon Basin of Nunavut. In 1999, overall uranium exploration expenditures reached $49 million while uranium exploration and surface development drilling amounted to over 89 000 m, down from about 95 000 m reported for 1998.

As in recent years, most of the overall exploration expenditures can be attributed to advanced underground exploration, deposit appraisal activities and care-and-maintenance expenditures associated with those Saskatchewan projects awaiting production approvals. In comparison, the Saskatchewan government estimates that "grass-roots" uranium exploration in the province amounted to $14 million in 1999, down some $8 million from the 1998 total of $22 million. Table 5 summarizes uranium exploration activity in Canada from 1986 to 1999.

In recent years, the number of companies with major exploration programs in Canada has declined. The top five operators,[3] accounting for a major portion of the $49 million expended in 1999, were: Cameco Corporation, Cigar Lake Mining Corporation, CRI, JNR Resources Ltd., and Argonaut Resources. Expenditures by CRI include those of Urangesellschaft Canada Limited.

RESOURCES

NRCan's annual assessment of domestic uranium supply capability provides a compilation of Canada's "known" uranium resources based on the results of an evaluation of company data. Uranium supply from Canada in the next decade will come from known resources, estimates of which are divided into three major categories, *measured*, *indicated* and *inferred*, that reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 2.

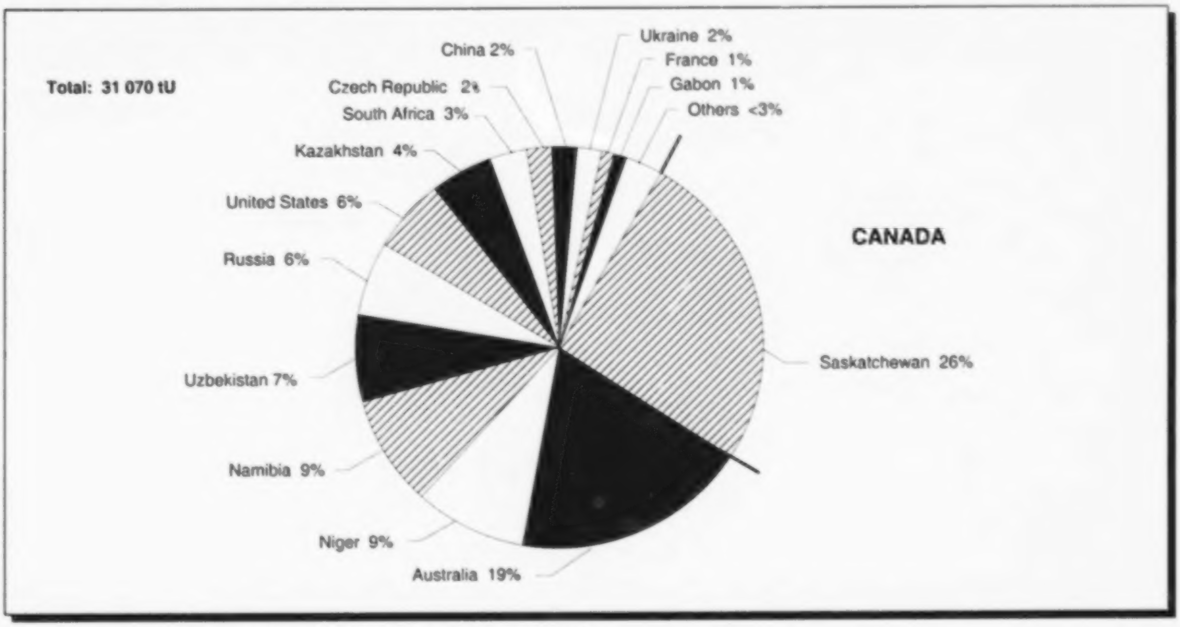
Recent NRCan assessments of Canada's uranium resources have been restricted to those recoverable from mineable ore at prices of $100/kgU or less. Table 6 shows the breakdown of the latest resource estimates, compared with those of the previous year. As of January 1, 2000, total recoverable known uranium resources were estimated at 417 000 tU, compared with 433 000 tU as of January 1, 1999. This downward adjustment of some 4% is the result of ongoing deposit appraisal.

SUPPLY CAPABILITY

In 2000, Canada's uranium supply capability increased as producers successfully brought the McClean Lake and McArthur River projects into commercial production, completing the first steps in the transition to the new high-grade mines in northern Saskatchewan. A continued smooth transition to other new mines, combined with timely licensing approvals and higher uranium prices, will be required to allow Canada's production capability to expand to its full potential of some 15 000 tU annually in the next 10 years.

Developments in the international uranium market, the rate at which projects clear environmental reviews, and uncertainty regarding the costs associated with certain of the planned new projects preclude projecting future production capability levels with much certainty. Table 7 ranks Canada among

Figure 4
World Uranium Production, 1999



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

the world's major producers, showing actual uranium production from 1995 through 1999. Figure 4 illustrates Canada's share of world output in 1990, compared with other major producers.

GOVERNMENT INITIATIVES

The *Nuclear Safety and Control Act* (NSCA) and associated regulations were brought into force on May 31, 2000. On that date, the Canadian Nuclear Safety Commission (CNSC) replaced the Atomic Energy Control Board (AECB). The revamped law and regulations, the first major overhaul of Canada's nuclear regulatory regime since 1946, reflect the increased focus on health, safety, security and environmental protection in recent years. Although the CNSC regulatory regime includes new requirements, such as lower radiation dose limits and strengthened security requirements, as well as increased penalties for non-compliance, in general the NSCA codified existing practices of the AECB.

On June 7, 2001, the Canadian government passed legislative amendments to ease, but not eliminate, the current foreign share ownership restrictions specified in the *Eldorado Nuclear Limited Reorganization and Divestiture Act*, Cameco's governing legislation. The changes raise the limits on non-resident share ownership from 5% to 15% and the aggregate share ownership voting right from 20% to 25%. These changes will allow Cameco to attract new investment capital and forge new strategic alliances.

URANIUM MARKET

Overview

There were no major developments directly affecting the uranium market in 2000. Activity in the spot market was minimal, and spot prices drifted continuously lower during the year. It was not until the Bush administration took office in January and prospects for further nuclear power development in the United States began to brighten that spot prices slowly began to rise again.

On July 26, 2000, the U.S. International Trade Commission (ITC) lifted restrictions on imports into the United States of uranium produced in Uzbekistan and Ukraine. At the same time, the ITC ruled that the existing suspension agreement limiting imports of Russian uranium into the United States should continue until 2004. By year-end, the Euratom Supply Agency was also contemplating amending its policy on diversification of sources of supply to allow further purchases by European Union utilities of uranium produced in Kazakhstan and Uzbekistan. These developments would leave uranium produced or held by the Russian Federation as the only uranium still subject to trade restrictions in the Western markets following the collapse of the former Soviet Union.

Uranium Prices

The decline in uranium spot market prices that began in the second quarter of 1999 continued throughout 2000 before finally beginning to recover during January 2001. The "restricted" spot market price, as reported by *TradeTech*,[4] fell steadily from US\$9.60/lb U_3O_8 at the beginning of the year to \$7.10/lb at year-end. The "unrestricted" spot part price, attributable to uranium from the former Soviet Union, began the year at US\$7.60/lb U_3O_8 and declined to US\$6.40/lb at the end of 2000.

The average price of Canadian export deliveries decreased from \$49.10/kgU (US\$12.70/lb U_3O_8) in 1999 to \$47.70/kgU (US\$12.40/lb U_3O_8) in 2000. In large measure, this reflected the growing dominance of long-term contracts with prices tied to published spot market prices. Table 8 shows the export price trend from 1977 to 2000 while Table 9 indicates actual exports of Canadian-origin uranium to principal customers from 1994 to 1999. The destination of Canada's exports of uranium on a cumulative basis (1995-99 inclusive) is illustrated in Figure 6, which highlights the growing importance of the United States as a customer.

REFINING AND CONVERSION

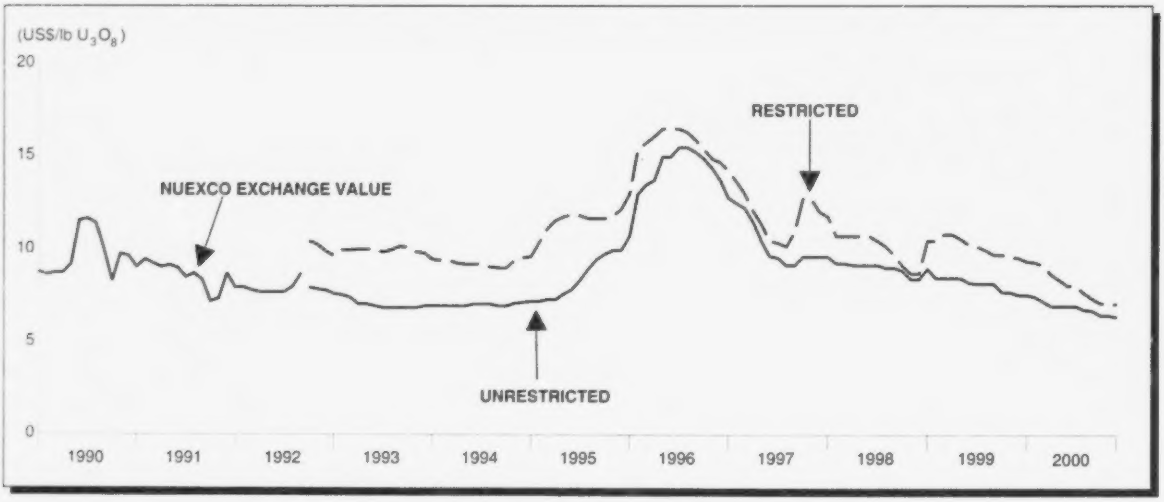
Cameco operates Canada's only uranium refining and conversion facilities, located at Blind River and Port Hope, Ontario, respectively. At the Blind River refinery – the world's largest – uranium mine concentrates from Canada and abroad are refined to uranium trioxide (UO_3), an intermediate product. The UO_3 is then trucked to the Port Hope facilities, which have about one quarter of the Western World's annual uranium hexafluoride (UF_6) conversion capacity and currently provide the only commercial supply of fuel-grade natural uranium dioxide (UO_2). UF_6 is enriched outside Canada for use in foreign light-water reactors while natural UO_2 is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. About 80% of the UO_3 from Blind River is converted to UF_6 while the remaining 20% is converted to UO_2. Table 10 tabulates Canada's production of refined and converted uranium, and notes the associated work force, from 1996 to 1999, inclusive.

Early in 2000, the Port Hope conversion facility received certification under ISO 14001, the most widely recognized international standard for environmental management systems.

OUTLOOK

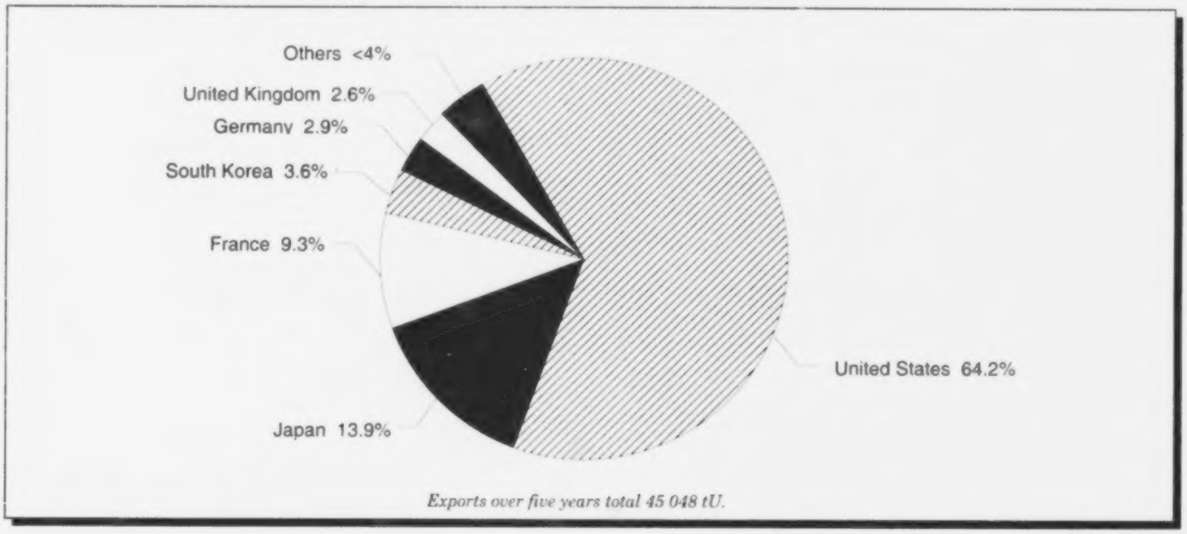
The continued liquidation of uranium inventories coupled with no significant changes in demand have led to poor market conditions for uranium producers. The depletion of inventories and improving prospects

Figure 5
Trend in Uranium Spot Prices, 1990-2000



Source: *TradeTech*.

Figure 6
Canadian Uranium Exports, by Country of Final Destination, 1995-99



Exports over five years total 45 048 tU.

Source: Canadian Nuclear Safety Commission.

for growth in the nuclear power generation sector should translate into improved market conditions in the near future. This, in turn, will allow Canada to remain a stable and competitive supplier of uranium to world markets for the foreseeable future.

Improved market conditions will be welcomed by Canadian producers as they continue an important period of transition in 2001. As mineable reserves at Key Lake, Rabbit Lake and Cluff Lake are depleted, new high-grade mines are being brought into production beginning with McClean Lake and McArthur River. Given favourable market conditions and timely regulatory approvals, the Cigar Lake mine is expected to enter into production in 2005. Continued success in bringing operations on stream will ensure that Canada remains the world's premier uranium producer well into the 21st century.

ENDNOTES

[1] John French, Advisor, Uranium Markets (tel. 613-995-7474) has contributed to the text in those sections dealing with international uranium market developments and uranium prices.

[2] *Canada's Uranium Industry in 2001 - Production Rebounds with New Mines on Stream,* NRCan mailing, October 2001.

[3] In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the NRCan survey are accounted for in the $49 million total expenditure for 1999.

[4] NUEXCO, an international uranium brokerage firm, was originally called the Nuclear Exchange Corporation. Several companies in the NUEXCO organization that were associated with uranium trading declared bankruptcy in early 1995. Certain of these have been reorganized and continue to provide brokerage services. NUEXCO's publication activities are carried on by *TradeTech*.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to chapter 65. (2) Information in this review was current as of June 1, 2001. (3) This paper on uranium and other information on developments in Canadian nuclear policy can be accessed on the Internet at nuclear.nrcan.gc.ca. (4) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not included as a reference, guide or suggestion to be used in trading, investment or other commercial activities. The author and Natural Resources make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. URANIUM PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1997-99

Province and Producer	Company Work Force[1] (Dec. 31) 1997	1998	1999	Annual Output[2] (tU) 1997	1998	1999
ATHABASCA BASIN, SASKATCHEWAN						
Cluff Mining (COGEMA Resources Inc., 100%)	222	158	151	1 964	1 039	1 234
Key Lake JV (Cameco operator)	316	285	277	5 434	5 392	3 715
Rabbit Lake JV (Cameco, 100%)	285	287	155	4 633	4 491	2 705
McClean Lake JV	225	265	283	–	–	560
McArthur River JV (pre-production)	57	89	157	–	–	–
Cigar Lake JV (pre-production)	. .	50	53	–	–	–
Total	1 105	1 134	1 076	12 031	10 922	8 214

Sources: Company annual reports; Canadian Nuclear Safety Commission open files.
– Nil; . . Not available.
[1] Figures are for company payroll employees only; on-site contractors (mining, construction, services, etc.) are not included. [2] Primary output only. With the closure of Rio Algom's Stanleigh operation at Elliot Lake in mid-1996, by-products from Cameco's refinery/conversion facilities are no longer processed in Canada. Prior to 1997, by-product totals were NOT included in the Canadian totals of primary uranium production noted above, but were included in the shipments and value of shipments figures provided in Table 2. Cameco is currently seeking approval to process refinery/conversion by-products at the Key Lake mill.

TABLE 2. VALUE[1] OF URANIUM SHIPMENTS[2] BY PRODUCERS IN CANADA, 1996-2000

	Unit	1996	1997	1998	1999	2000p
Total producer shipments	tU	11 396	11 127	9 984	10 157	9 921
Total value of shipments	$ millions	624	554	500	500	485

Source: Natural Resources Canada.
p Preliminary.
[1] Value of shipments is estimated from an average market price. [2] Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 1999

Operating Entity (Operator)/Location	Ore-Processing Plant[1] Capacity Nameplate	Recovery Overall	Annual Throughput Total Ore	Ore Grade
	(t/d)	(%)	(t)	(%)
Cluff Mining (COGEMA Resources Inc.)/ Cluff Lake, Saskatchewan	800	97	258 180	0.50
McClean Lake JV (COGEMA Resources Inc.)/ McClean Lake, Saskatchewan	300	95	23 090	0.30
Rabbit Lake (Cameco Corporation)/ Rabbit Lake, Saskatchewan	2 000	97	204 590	1.30
Key Lake JV (Cameco Corporation)/ Key Lake, Saskatchewan	925	97	215 700	1.75

Sources: Corporate annual reports; Canadian Nuclear Safety Commission open files.
[1] Figures are rounded.

TABLE 4. CANADIAN URANIUM MINING PROJECTS PLANNED FOR PRODUCTION AS OF JUNE 1, 2001

Project, Province or Territory/Operator	Owners Share (%)	Deposit Type/ Discoverer and Discovery Date	Resources (Company Estimates as of March 1, 2000)	Ore Grade and Notes on Deposits	Mining Method, Milling Rate and Capacity	Project Particulars and Status	Location of Project/ Notes of Interest
Cigar Lake, Sask./ Cigar Lake Mining Corporation	Cameco (50.025), COGEMA Resources Inc. (37.100), Idemitsu (7.875), TEPCO (5)	Unconformity-related/ COGEMA Resources Inc., 1981	Overall property 142 000 tU, *mineable*	Overall property grade of 14% U; grades vary from 5% to 70% U; orebody at depth of 450 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake and Rabbit Lake; contributing from 2300 to 6900 tU/y	$555 million project; test mining completed in 1992; EIS submitted in October 1995; Joint Panel reports November 1997; government response April 1998; comprehensive study of Rabbit Lake milling option ongoing	670 km N of Saskatoon; 500-m-deep shaft sunk; brine freezing of ground is required to mine the ore; production to begin in 2005
Midwest, Sask./COGEMA Resources Inc.	COGEMA Resources Inc. (54.8), Redstone Resources Inc. (20.7), Tenwest Uranium Ltd. (20), OURD (4.5)	Unconformity-related/ Esso Minerals Canada, 1977 (interests of Bow Valley, Numac Oil & Gas, *et al* bought by partners)	Overall property 13 800 tU, *mineable*	Overall property grade of 4.5% U; grades vary from 2% to 30% U; orebody at depth of 200 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake; contributing 2300 tU/y	$80 million co-venture with McClean; in 1993, Joint Panel rejects proposal; new EIS in 1995; final hearings August 1997; Joint Panel report November 1997; government response April 1998	710 km N of Saskatoon; 185-m-deep test-mine shaft; new operator, COGEMA Resources Inc., revised EIS; start-up subject to feasibility study
Kiggavik, Nunavut/ Urangesellschaft Canada Limited	Urangesellschaft (79), COGEMA Resources Inc. (20), Daewoo Corp. (1)	Unconformity-related/ Urangesellschaft, 1977	Overall property 15 000 tU, *mineable* (more incl. Andrew Lake *et al*)	0.41% U average overall; depth Centre pit 100 m, Main pit 200 m	Open-pit mining methods; 1200 t/d mill feed; output rate of 1200 tU/y originally expected	EIS submitted but project deemed deficient by Panel; COGEMA Resources Inc. expected to review project and submit new EIS	75 km W of Baker Lake; start-up not likely before 2005; >11-year mine life with tributary ore included

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Urangesellschaft Canada Limited, operated by COGEMA Resources Inc., is a subsidiary of Compagnie générale des matières nucléaires (COGEMA) of France. Idemitsu Uranium Exploration Canada Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co., Ltd. of Japan. TEPCO Resources Inc. is a subsidiary of Tokyo Electric Power Co., Inc. (TEPCO), Japan's largest nuclear power utility. Redstone Resources Inc. is a subsidiary of Franco-Nevada Mining Corporation Limited. Tenwest Uranium Ltd. is a wholly owned subsidiary of Denison Mines Limited.

TABLE 5. URANIUM EXPLORATION ACTIVITY IN CANADA, 1986-99

Year	Expenditures[1]	Drilling[2]	Million-Dollar Projects[3]
	($ millions)	(km)	(number)
1986	33	162	11
1987	37	164	12
1988	59	201	11
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4
1993	40	62	5
1994	36	67	8
1995	44	75	10
1996	39	79	8
1997	58	104	6
1998	60	95	6
1999	49	89	3

Source: Natural Resources Canada.
[1] Direct exploration and drilling expenditures in current dollars; from the late 1980s, includes advanced underground exploration and deposit appraisal expenditures; from the mid-1990s, may also include care-and-maintenance costs associated with deposits awaiting production approvals.
[2] Exploration and surface development drilling; excludes development drilling on producing properties. [3] Number of projects where direct exploration and drilling expenditures exceeded $1 million in current dollars.

TABLE 6. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE,[1] JANUARY 1, 1999, AND JANUARY 1, 2000

Price Ranges Within Which Mineable Ore is Assessed[2]	Measured		Indicated		Inferred	
	1/1/99	1/1/00	1/1/99	1/1/00	1/1/99	1/1/00
			(000 tU)			
Up to C$50/kgU	211	201	73	29	87	128
C$50 to $100/kgU	1	–	41	39	20	20
Total	212	201	114	68	107	148

Source: Natural Resources Canada.
– Nil; . . Not available.
[1] Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75-85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Canada's weighted average ore processing recovery for existing conventional operations exceeded 97% over the 1999/2000 period.
[2] The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of $100/kgU was used by Natural Resources Canada to illustrate those resources that were of economic interest to Canada during the survey period.
Note: $1/lb U_3O_8 = $2.6/kgU.

TABLE 7. PRODUCTION OF URANIUM IN CONCENTRATES BY SELECTED MAJOR PRODUCING COUNTRIES, 1995-99

	1995	1996	1997	1998	1999
			(tonnes U)		
Canada[1]	10 530	11 750	12 030	10 920	8 210
Russia	2 200	2 600	2 000	2 000	2 000
Kazakhstan	1 580	1 210	1 000	1 270	1 350
Uzbekistan	1 700	1 460	1 760	1 930	2 130
China	780	560	500	500	500
United States	2 324	2 430	2 170	1 810	1 810
South Africa	1 420	1 440	1 100	990	980
Namibia	2 010	2 450	2 900	2 760	2 690
Australia	3 710	4 970	5 520	4 910	5 980
Niger	2 980	3 320	3 500	3 730	2 920
France	1 020	930	750	510	440
Gabon	630	570	470	730	290
Other[2]	2 730	2 540	1 990	1 730	1 770
Total[3]	33 610	36 230	35 690	33 790	31 070

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency; miscellaneous corporate, national and international reports.

[1] Includes refinery/conversion facility by-product prior to 1997; differs from primary production figures shown elsewhere. [2] Includes Argentina, Belgium, Brazil, Bulgaria, the Czech Republic, Germany, Hungary, India, Israel, Japan, Mongolia, Pakistan, Portugal, Romania, Spain, Ukraine and Yugoslavia. [3] Totals are of the listed figures only and represent global production.

Note: Country figures are rounded to the nearest 10 tU.

TABLE 8. CANADIAN URANIUM EXPORT PRICE,[1] 1977-2000

	Average Export Price		Spot Sale
Year	Current Dollars	Constant 2000 Dollars	Portion of Deliveries
	($/kgU)[2]		(%)
1977	110	272	n.r.
1978	125	290	n.r.
1979	130	276	n.r.
1980	135	258	n.r.
1981	110	190	1
1982	113	179	1.5
1983	98	148	10
1984	90	131	26
1985	91	129	20
1986	89	123	21
1987	79	104	35
1988	79	100	13
1989	74	89	<1
1990	71	83	<1
1991	61	70	<2
1992	59	66	<1
1993	50	56	<1
1994	51	56	<1
1995	47	50	2
1996	53.60	56.61	1
1997	51.30	53.68	<1
1998	51.10	53.77	<2
1999	49.10	50.86	<1
2000	47.70	47.70	<1

Source: Natural Resources Canada.

n.r. Not reported.

[1] Derived annually based on the average price for all deliveries made by Canadian producers to export customers in the given year. [2] $/kgU x 0.38465 = $/lb U_3O_8.

Notes: Pre-1996 prices are rounded to the nearest dollar. Constant dollar values are derived using the Implicit Price Index for Gross Domestic Product.

TABLE 9. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1994-99

Country of Final Destination	1994	1995	1996	1997	1998	1999
	(tonnes of contained uranium[1])					
Belgium	115	3	115	–	–	–
France	766	1 016	679	587	67	1 819
Germany	465	348	776	184	–	–
Japan	3 443	363	1 490	1 968	1 310	1 116
South Korea	455	290	261	315	444	309
Spain	274	186	103	160	–	121
Sweden	–	84	142	450	147	–
Taiwan	–	–	–	–	–	107
United Kingdom	50	188	250	374	345	–
United States	4 938	5 702	7 407	6 187	5 962	3 674
Total	10 506	8 180	11 223	10 225	8 274	7 146

Source: Canadian Nuclear Safety Commission.
– Nil.

[1] Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.

TABLE 10. URANIUM PROCESSING PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1996-99

Process and Location (Nameplate Capacity)	Production				Site Work Force			
	1996	1997	1998	1999	1996	1997	1998	1999
	(tU)				(number)			
Refining at Blind River (18 000 tU as UO_3)	10 190	12 195	12 031	11 360	90	102	96	98
Conversion at Port Hope (12 500 tU as UF_6 and 2800 tU as UO_2)	10 127	12 594	11 169	11 231	257	277	271	272

Source: Cameco Corporation.

Zinc

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Market fundamentals for world zinc markets in 2000 remained strong, with good growth in overall demand, falling stock levels and increased metal production. Prices remained strong for the first nine months of the year but, while up overall from 1999 levels, began to decline sharply in the fourth quarter as concerns about the degree to which demand growth will slow in the United States, coupled with new smelter and mine capacity coming on stream for 2001, began to put downward pressure on prices.

World zinc usage reached 8.83 Mt in 2000, according to preliminary figures from the International Lead and Zinc Study Group (ILZSG), a total that was just slightly less than total world refined metal production of 8.9 Mt. Western World zinc demand exceeded production by 815 000 t. This supply deficit was largely offset, however, by net exports of zinc metal to the West by Eastern countries. Zinc metal stocks held on the London Metal Exchange (LME) fell steadily through the year to 195 000 t, a decline of 84 000 t since the end of 1999. Reported producer stocks were 7000 t higher than in 1999 at a total of 305 000 t.

Cash settlement prices on the LME averaged US$1128.11/t in 2000, up 4.7% over 1999. Three-month prices averaged $1137.34/t.

CANADIAN DEVELOPMENTS

Preliminary data indicate that Canadian mine production of zinc totaled 996 921 t in 2000, or 2.4% lower than in 1999. Lower-than-expected output at Myra Falls in British Columbia and temporary problems at the Bell Allard, Bouchard Hébert and Langlois mines in Quebec, the Brunswick mine in New Brunswick, and the Ruttan mine in Manitoba all contributed to the lower output in Canada in 2000 (Figure 2).

Zinc metal production in Canada was up slightly from 776 927 t in 1999 to 779 586 t in 2000, with increases from imported feed more than offsetting lower domestic sources. Canada ranked second after China in terms of zinc metal production and third after China and Australia in terms of mine production in 2000 (Figure 3).

British Columbia

Rock stability problems at Cominco Ltd.'s Sullivan mine that had started at the end of 1999 continued to result in lower concentrate production in early 2000. Improvements at the mine during the first quarter, however, resulted in higher zinc and lead concentrate production. The mine is expected to continue to operate until the planned closure date in December 2001. In December 2000, Cominco announced that it would be reducing zinc metal production at its Trail smelter by about 20 000 t through to January 2001 as the result of a power swap agreement with a major U.S. energy company.

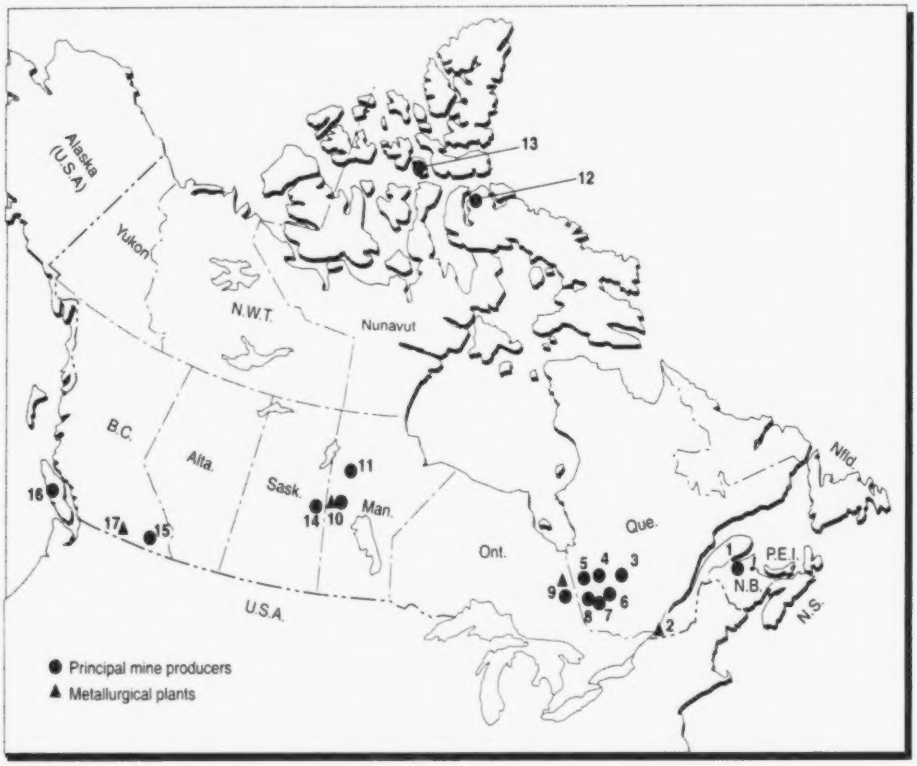
Yukon

Work continued throughout the year on the Finlayson project in southeastern Yukon Territory. Expatriate Resources Ltd. created the Finlayson project by consolidating its interests in its wholly owned mineral lands, its interest in the Wolverine Joint Venture (60% Expatriate, 40% Atna Resources Ltd.), and mineral lands acquired from Cominco Ltd. In March, Expatriate announced the acquisition of all of Cominco's interests in the Kudz Ze Kayah deposit and surrounding mineral lands. With the acquisition of Kudz Ze Kayah, the emphasis of the prefeasibility study shifted to co-development of the Finlayson project. In November, Expatriate and Atna completed a prefeasibility study indicating that the Finlayson project is technically and economically viable.

Saskatchewan/Manitoba

Hudson Bay Mining & Smelting Co., Limited, a wholly owned subsidiary of Anglo American plc, officially opened the Chisel North mine near Snow Lake, Manitoba, in June. The $32 million capital investment is part of the company's $400 million

Figure 1
Zinc Producers in Canada, 2000


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
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16
17
● Principal mine producers
▲ Metallurgical plants

Numbers refer to locations on map above.

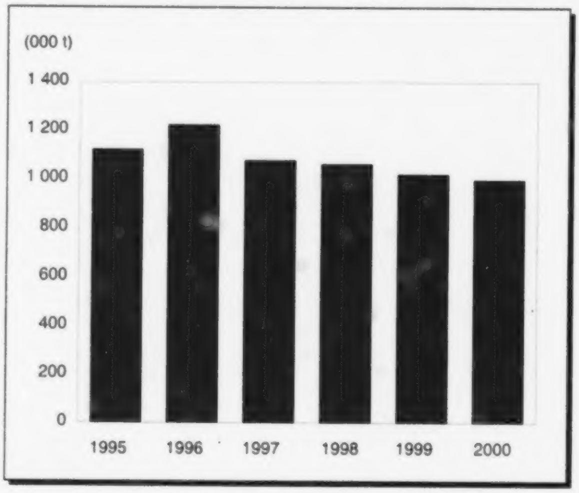
Zinc-Producing Mines

1.	Brunswick	Noranda Inc.
3.	Langlois	Breakwater Resources Ltd.
4.	Bell Allard	Noranda Inc.
5.	Selbaie	Les Mines Selbaie
6.	Louvicourt	Aur Resources Inc./Novicourt Inc.
7.	LaRonde	Agnico Eagle Mines Limited
8.	Bouchard-Hébert	Breakwater Resources Ltd.
9.	Kidd Creek	Falconbridge Limited
10.	Callinan	Hudson Bay Mining and Smelting Co., Limited
	Trout Lake	Hudson Bay Mining and Smelting Co., Limited
	Chisel North	Hudson Bay Mining and Smelting Co., Limited
	777	Hudson Bay Mining and Smelting Co., Limited
11.	Ruttan	Hudson Bay Mining and Smelting Co., Limited
12.	Nanisivik	Breakwater Resources Ltd.
13.	Polaris	Cominco Ltd.
14.	Konuto Lake	Hudson Bay Mining and Smelting Co., Limited
15.	Sullivan	Cominco Ltd.
16.	Myra Falls	Boliden Limited

Zinc Metallurgical Plants

2.	Valleyfield	Canadian Electrolytic Zinc Limited
9.	Kidd Creek	Falconbridge Limited
10.	Flin Flon	Hudson Bay Mining and Smelting Co., Limited
17.	Trail	Cominco Ltd.

Figure 2
Canadian Mine Production of Zinc, 1995-2000



Source: Natural Resources Canada.

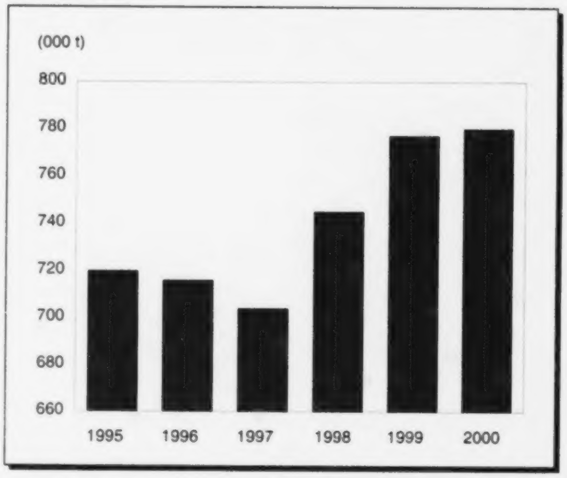
investment in the 777 project and includes the refurbishment of the Snow Lake zinc concentrator. Zinc concentrate from the Snow Lake concentrator will be trucked 200 km southwest to the Flin Flon smelter. In addition to the Chisel North mine development, work continued on the 777 mine in Flin Flon, which is expected to go into production in 2003. Construction of a new $100 million electrolytic tankhouse also continued. In August, a severe rainstorm temporarily shut down the Ruttan mine at Leaf Rapids, Manitoba. A power outage shut down the underground pumps to the mine.

Ontario

Falconbridge Limited approved the development of Mine D (Deep) at the Kidd Creek copper-zinc mine at Timmins, Ontario. This mine extension project will deepen the mine from 2100 m to 3100 m below the surface and contribute 2 Mt/y of ore when full production is reached in 2004. When completed, the project will make the Kidd mine the deepest base-metal mine in the world. The first stage of the project is estimated to contain 15.7 Mt of ore grading 2.8% copper, 5.7% zinc and 58 g/t silver. Current estimates for the second stage are for 10.5 Mt of ore grading 2.2% copper, 5.3% zinc and 97 g/t silver.

Boliden Limited announced that it was transferring its corporate operations from Toronto back to Sweden in an attempt to cut costs and to be nearer its main smelter and refining operations. Shares in the company will continue to be listed on both the Toronto Stock Exchange and the OM Stockholm Exchange. Boliden owns the Myra Falls zinc mine in British Columbia and has operations in Chile and Europe.

Figure 3
Canadian Refined Zinc Metal Production, 1995-2000



Source: Natural Resources Canada.

Quebec

In northwestern Quebec, Noranda Inc. reported good drilling results from an exploration program to find new sources of feed for its milling and smelting operations in the Matagami region. The presence of a significant zinc and copper deposit consisting of three distinct ore zones (Equinox, Perseverance and Perseverance West) was discovered within the Matagami mining camp. Preliminary results for the Equinox zone indicate an inferred resource of 5 Mt grading 16.8% zinc, 1.3% copper, 34 g/t silver and 0.4 g/t gold. Work continues to further define the zones.

In May, Breakwater Resources Ltd. acquired the Bouchard-Hébert and Langlois zinc mines, located in northwestern Quebec, from Cambior Inc. Earlier in the year, Cambior announced mechanical problems with the semi-autogenous (SAG) mill at the Bouchard-Hébert mine, which resulted in a temporary shut-down of the mill. The repaired SAG mill was back in production in October and reached its full capacity of 2900 t/d by year-end. In November, Breakwater announced that it would be temporarily suspending operations at the Langlois mine due to operating problems associated with the main ore pass system. The difficulties with the ore pass system, combined with the decline in metal prices and high treatment charges, made it uneconomic for the company to operate the mine. By year-end, Breakwater announced that it was working on a project to optimize the site and that it may restart production by the first quarter of 2002.

Billiton Plc finalized a deal to purchase Toronto-based Rio Algom Limited in November. Billiton Base Metals' zinc operations in Canada include Les Mines Selbaie, located in northwestern Quebec. Following exhaustion of current ore reserves, processing is expected to continue at Selbaie until June 2004 from low-grade ore stockpiled during the mining period. A trust fund is also in place to guarantee closure and reclamation costs. Billiton Base Metals also owns a 25% royalty interest in the annual net proceeds of production from the Polaris mine in Nunavut, operated by Cominco.

New Brunswick

Breakwater Resources' Caribou mine has remained on care and maintenance since August 1998. Based on pilot plant testing, a plan to restart the mine was completed in the first quarter of 1999. The plan indicated that the flotation capacity of the mill will have to be expanded by about 40% in order to achieve the desired metallurgical results. The capital costs required to restart the mine are in the order of $12 million, excluding working capital. A decision to re-open the mine still awaits higher metal prices.

Nova Scotia

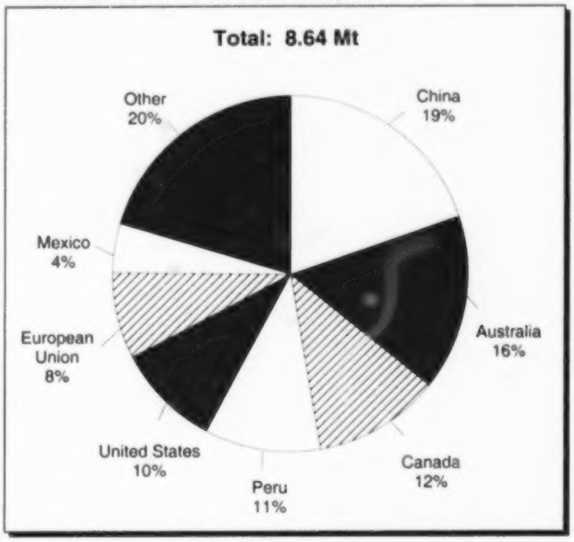
Australia-based Pasminco Limited continued to seek the necessary provincial environmental permits for the Gays River zinc property. While the company has already received its federal approvals, it awaits permits from the provincial departments of natural resources and labour. Pasminco acquired the former Gays River mine from Savage Resources Canada Ltd. Pasminco has plans to spend $5 million-$10 million during the life of the mine; however, the company has stated that the project will not proceed until there is a significant improvement in world zinc prices.

WORLD DEVELOPMENTS

Total world mine production of zinc was 8.6 Mt in 2000, an increase of about 7% from 1999. The opening of the Century mine in Australia, together with the new Lisheen mine in Ireland, Rey de Plata in Mexico and the re-opening of Los Frailes in Spain, all contributed to the rise in world mine output (Figure 4).

World zinc metal production reached 8.93 Mt, an increase of 5.3% over 1999, due largely to increased production in Australia and China and, to a lesser extent, expansions in Italy, South Korea and Mexico. Western World zinc metal production rose for the fourth consecutive year by 4.5% to 6.1 Mt in 2000 (Figure 5).

Figure 4
World Zinc Mine Production, 2000



Source: International Lead and Zinc Study Group.

United States

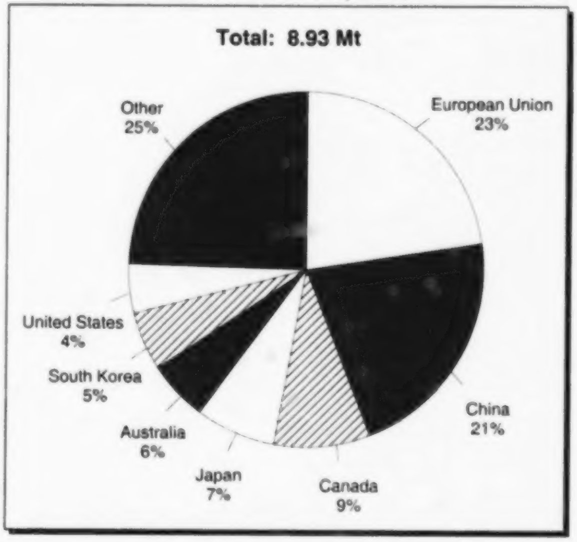
The re-opening of Pasminco's Clinch Valley mine in Tennessee in July, together with increased production at Cominco's Red Dog mine in Alaska, led to an overall increase in zinc mine production of about 3% in 2000. The Red Dog mine is the leading zinc producer in the United States, accounting for more than half of total U.S. production, which totaled 828 000 t in 2000.

Cominco announced that it had invested in Metallic Power Inc. of Carlsbad, California, a developer of recyclable zinc-air fuel cells. The capital from the investment will be used to fund product development and commercialization. In September, Cominco endorsed the decision made by the board of its subsidiary, Cominco American, Inc., to rebuild and re-open the Pend Oreille zinc-lead mine near Metaline Falls, Washington. Cominco will begin the US$70 million project with a two-year construction program in October that will involve refurbishment of the concentrator and the sinking of an internal shaft. The mine is scheduled to begin production in September 2002 at a rate of 84 000 t/y of zinc concentrates and 13 000 t/y of lead concentrates. The concentrates will be shipped to its nearby Trail operations in southern British Columbia.

Latin America

Mexico's Industrias Peñoles, S.A de C.V. completed the expansion of its Torreón zinc smelter in

Figure 5
World Zinc Metal Production, 2000



Source: International Lead and Zinc Study Group.

December to 220 000 t/y. About 30% of the production from the expanded facility will supply the company's nearby zinc alloy plant at Permejillo, which recently expanded capacity by 10 000 t to 100 000 t/y.

Elsewhere in Mexico, Peñoles opened the US$39 million Rey de Plata mine in Tehuixtla, Guerrero in October, raising the company's average annual zinc production by about 12%. A joint-venture project between Peñoles (51%), Dowa Mining Co., Ltd. (39%) and Sumitomo Corporation (10%), the mine is Mexico's fifth largest zinc producer.

Brazilian zinc producer Cia Paraibuna de Metais SA increased its production capacity to 92 400 t/y following a US$100 million debottlenecking and expansion project. Next year the company will begin work on a project to further increase production to 170 000 t/y.

In Chile, Breakwater Resources' El Toqui mine, located 1350 km south of Santiago, reported operating earnings of $0.7 million in 2000 compared with $2.4 million in 1999. Development work was started on the ramps to access new reserve areas. An internal study is reportedly under way for a possible expansion of at least 25% of the production capacity of the mill. The study is expected to be completed in the third quarter of 2001. Elsewhere in Chile, Breakwater's El Toqui subsidiary conducted surface exploration work at the Mallin-Monica sector and is carrying out more exploration work at the property. The company also conducted exploration in the Estatuas area.

In Peru, work continued on development of the Antamina copper-zinc project. By year-end, mine development was more than 80% complete, ahead of schedule and within budget. A joint venture between Noranda (33.75%), Billiton Plc (33.75%), Teck Corporation (22.5%) and Mitsubishi Corporation (10%), the mine is expected to begin full commercial production in early 2002. Construction is expected to be completed in May 2001. The first concentrate will be transported to the port through a 300-km pipeline. Proven and probable ore reserves of the planned open pit are calculated to be 559 Mt with an average grade of 1.23% copper, 1.03% zinc, 13.7 g/t silver and 0.029% molybdenum.

Europe

The Lisheen mine was officially opened in June in Ireland. An equal joint-venture project between Toronto-based Ivernia West Inc. and Anglo American plc, the Lisheen mine, located near Thurles, County Tipperary, is the fifth largest zinc-lead mine in the world. It is expected to produce 4.83 Mt of zinc and lead concentrates during its 14-year lifespan. Full production capacity is expected by mid-year 2001. At full production Lisheen will operate at the rate of 1.5 Mt/y of ore and produce some 160 000 t/y of contained zinc in concentrates.

Rio Tinto plc and Boliden, joint owners of the Norzink A/S zinc smelter at Odda, Norway, announced their intention in early October to sell their 100% interest in the facility to Finland's Outokumpu Oyj by year-end. Outokumpu agreed to pay US$180 million for the plant, which has an annual production capacity of 150 000 t of zinc metal.

Vancouver-based EuroZinc Mining Corporation continued to work towards earning up to a 75% interest in the Aljustrel mine in Portugal by advancing the project to the production stage. In December, the company announced that it had agreed to a private placement to raise up to $1.64 million. The money will be used for general working capital as the company arranges project financing for bringing the Aljustrel zinc project into production. In November, the company announced that an incentives package worth US$32 million has been agreed to between the Portuguese government and EuroZinc for the Aljustrel project. The Portuguese government holds a 25% stake in the project.

In October the future of the Los Frailes zinc mine in Spain was put in doubt after Boliden Limited announced that it will not make any further investment in the project. The company will proceed with mining at pit 2 but cannot proceed with planned operations at pit 3 at the mine. Boliden's Spanish subsidiary, Boliden Apirsa SL, filed a court application for bankruptcy protection to preserve assets, pay creditors and ensure that operations at Los Frailes continue until the completion of pit 2, planned for October 2001. The company has stated that the mine will close if it does not succeed in finding a way to continue operations. Los Frailes has been operating at a loss since operations were restarted in the second quarter of 1999. The mine was forced to close in 1998 following a failure in the mine's tailings dam.

In August, Enirisorse SpA sold its interests in Pertusola Sud SpA, subject to government approval, to Zincocalabra Spa, a new company owned by a private group of companies led by Cogefin SpA. Pertusola Sud operated the 100 000-t/y Crotone zinc smelter, which has been closed since last year. Zincocalabra intends to build a new zinc smelter with a capacity of 185 000 t/y. The sale of Pertulsola represents the last stage in Enirisorse's divestment of its mineral and metal assets.

In June, Metaleurop S.A. announced the closure of its Harzer Zink plant near Harlingerode, Germany. The decision to close the 20 000-t/y plant, which uses a vertical retort process, was made as a result of the plant's inability to reach its expected profitability and to comply with current environmental regulations without a significant investment by the company. The production of zinc oxides at Harlingerode was not affected by the decision.

Asia

Cominco announced in June that it had entered into exclusive negotiations with Iran Zinc Mine Development Company (IZMDC) regarding the Angouran zinc deposit in northwestern Iran. The Angouran deposit is a small-scale, open-pit zinc mine that currently produces about 400 000 t/y of oxide ore grading 33% zinc. Most of the ore is processed in a plant at Dandi, 20 km east of the mine, to produce zinc calcine for subsequent treatment by local refineries. Cominco is seeking to establish a joint venture to carry out a feasibility study and, if attractive, build a plant to leach run-of-mine oxide ore to produce 100 000 t/y of refined zinc.

China's zinc smelting capacity is expected to continue to grow over the next five years, particularly in the northwestern part of the country. Reports indicate that the government will only authorize the construction of new zinc smelting plants with a capacity greater than 50 000 t/y. In addition, some existing zinc smelters will be encouraged to upgrade their capacity to 50 000 t/y or more. Some 20 000 t/y of existing capacity is to be phased out by 2005. The government has declared its northwestern region open for foreign investment, and proposals for several zinc mines in the western part of the country are under review. As a result of the planned smelter expansions, zinc concentrate imports are expected to rise. Several zinc smelter capacity expansions to be completed this year include Shaanxi Shangluo smelter (15 000-t/y expansion to a total of 25 000 t/y), Jijie smelter (12 500-t/y expansion to 20 000 t/y) and Longcheng Chemical General Plant in Liuzhou, Guangxi province (30 000-t/y expansion by year-end to 60 000 t/y). Also by the end of 2000, the Kaifeng Zinc smelter was expected to complete an expansion from 16 000 t/y to 36 000 t/y. Xicheng Zinc Company was expected to produce close to 27 000 t of zinc in 2000, which is close to the plant's recently expanded capacity of 30 000 t/y. In October, Xicheng Zinc announced that it had delayed plans until 2002 to expand its capacity to around 60 000 t/y. In June, Billiton Plc, through its wholly owned subsidiary Billiton China BV, signed a joint-venture agreement to develop the LanPing zinc deposit in Yunnan province. The agreement, signed between Billiton and LanPing Nonferrous Metals Company, will give Billiton a 65% interest in the project.

Africa

Breakwater Resources signed a letter of intent with Algeria's natural resource agency, the Office National de la Recherche Géologique et Minière (ORGM). The letter entitles Breakwater to earn up to a 90% interest in the Oued Amizour lead-zinc deposit with a total resource estimated at 30.2 Mt grading 5.5% zinc and 1.4% lead. Under the agreement, Breakwater must complete a feasibility study, arrange financing, and construct and bring the project into production. ORGM will retain a 10% net profit interest in the project once Breakwater recovers its full capital investment. Breakwater will pay ORGM US$5 million for the property from the net profits of the operation over a five-year period beginning in the first year of production.

In September, Anglo American plc announced plans to proceed with the US$454 million development of its Skorpion zinc mine project near Rosh Pinah in southern Namibia. Production from the 150 000-t/y zinc mine is planned for the second quarter of 2003.

Australia

Noranda announced in December that it had decided to exercise its option to acquire a 75% stake in the Lady Loretta project for $17 million from Buka Minerals Limited. The project is located some 140 km northwest of Mt. Isa in Queensland. Noranda's drilling program increased the estimated mineral resource from 8.3 Mt grading 18.4% zinc, 8.3% lead and 125 g/t silver to 13.6 Mt grading 17.1% zinc, 5.9% lead and 97 g/t silver.

The new Century mine, owned and operated by Pasminco Limited, was officially opened in April. The A$100 million project was completed under budget and ahead of schedule; it comprises a mine, located at Lawn Hill, and a port and dewatering facility at Karumba in Queensland. The mine and port are connected by a 304-km underground pipeline that pumps zinc and lead concentrate from the mine site to the port. At the time of the official opening, the mine had already produced some 100 000 t of concentrate that was shipped to Pasminco's Budel Zink smelter in the Netherlands. Shipments to other customers began in May. By the end of 2001, the mine will have an annual capacity of 5 Mt of ore yielding 888 000 t of zinc concentrate and 70 000 t of lead.

RECYCLED ZINC

Recycled zinc includes high-purity zinc refined from the treatment of electric arc furnace (EAF) dusts, remelted zinc with a purity less than 98.5% zinc, and scrap zinc used in the production of zinc alloys. According to ILZSG, the amount of recycled zinc recovered in the Western World has risen steadily in recent years, reaching 2.04 Mt in 2000.

The recycling of galvanized steel has become an important source of recycled zinc with processes developed to treat EAF dusts or to de-zinc steel before it is remelted. The Waelz kiln is the most common method of processing EAF dusts. Waelz oxides are treated in imperial smelting furnaces for the production of refined zinc. The requirement of Waelz kilns to be near their feed source, i.e., steel mill complexes, would suggest that treatment of these dusts will be most important in the United States, Japan and Western Europe.

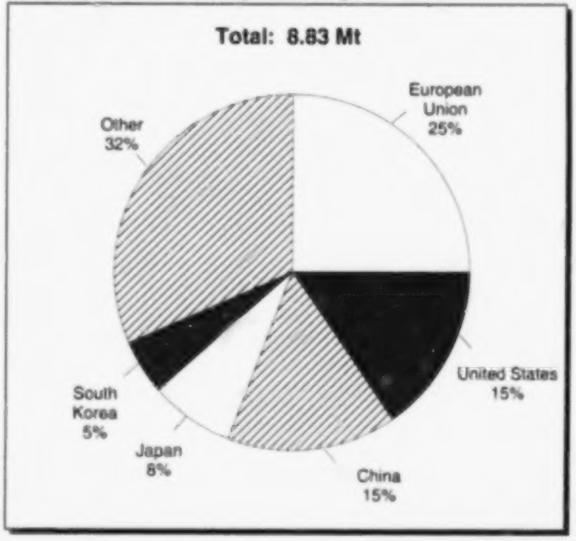
ZINC USAGE

Zinc use worldwide grew for the eighth consecutive year by about 4.0% in 2000 to reach 8.83 Mt. Preliminary figures from ILZSG for 2000 indicate that Western World demand increased from 6.7 Mt in 1999 to just over 7 Mt in 2000 (Figure 6). The main engine for growth in world demand came from Asian countries. European demand grew by 3.3% while growth in the United States was 3.5%. Zinc use in Canada increased from a reported 169 000 t in 1999 to 176 000 t in 2000, a rise of about 4.0%.

The galvanic protection of steel has been the predominant end use of zinc in recent years and currently represents 47% of zinc usage. Zinc is used extensively in the automotive and construction industries for corrosion protection and remains one of the most cost-effective means of protecting steel against corrosion. The zinc coating acts as a physical barrier and as an oxidant. The oxide, in turn, acts as a further barrier to corrosion (Figure 7).

The desire to reduce weight and improve fuel efficiency has led to an increased use of galvanized steel in the automotive industry to protect the thinner gauges of steel from corrosion. In North America, the consumer trend toward all-purpose vehicles or sport utility vehicles has increased the use of zinc-coated automotive sheet. Both hot-dipped and electrogalvanized steel are used, the thicker coating of hot-dipped steel giving more corrosion protection to unexposed surfaces and the thinner coating of electrogalvanized steel providing a smoother finish for exposed, painted surfaces.

Figure 6
Refined Zinc Use, by Country, 2000



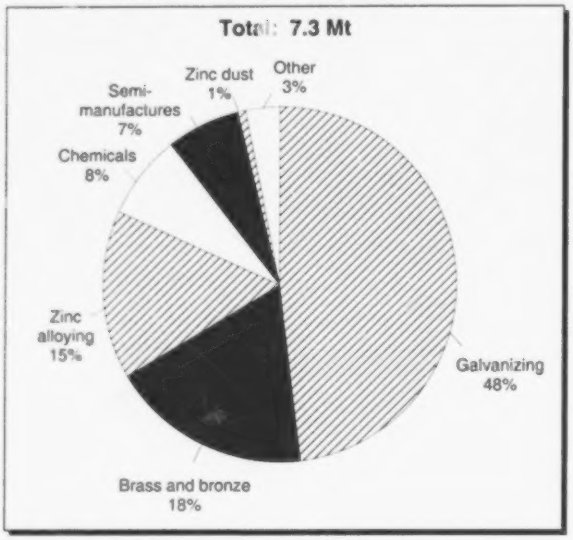
Source: International Lead and Zinc Study Group.

Galvanized steel is also used in construction for structural components, roofing, siding and reinforcement bars. Nails and other building materials are often hot dip galvanized. Zinc and zinc-aluminum thermally sprayed coatings are used for the long-term corrosion protection of large steel structures such as bridges and hydro-electric transmission towers.

With the relatively high cost of lumber, fabricated hot-dipped structural steel is becoming cost-competitive for use in residential home construction. The number of steel-framed homes built yearly in the United States has risen steadily and was estimated at 250 000 in 1997. The North American Steel Framing Alliance (NASFA) continues to work towards achieving a 25% market share for light-gauge steel framing in the residential construction market. The NASFA estimates that a 25% market share would require additional production of 85 000 t/y of zinc for galvanizing.

Galvanized steel studs have a number of advantages over wood, including more stable prices, reduced

Figure 7
Western World Zinc Markets, 1999



Source: International Lead and Zinc Study Group.

weight, immunity to warping or termites, fire resistance and recyclability. However, disadvantages include their tendency to bend or dent if handled improperly and the need for specialized training and tools.

A number of zinc alloy coatings have been developed over the years with superior qualities compared to pure zinc in specific applications. These include Galfan (90% zinc, 5% aluminum and the remainder rare earth elements) and Galvalume (55% aluminum, 43.4% zinc and 1.6% silicon), as well as zinc-iron and zinc-nickel alloys. Galfan, for example, exhibits higher formability and paintability than other coatings, and zinc-nickel alloys reduce the reactivity of high-silicon steels.

Canada's hot-dip galvanized steel and Galvalume capacity of 1 902 000 t/y is located at the facilities of Dofasco Inc. and Stelco Inc. in Hamilton and DNN Galvanizing Corporation in Windsor, both in Ontario, and Sorevco Inc. in Coteau-du-Lac, Quebec.

The manufacture of brass and bronze is the second most important use of zinc, accounting for 19% of total usage. The use of brass and bronze is highly dependent on the level of activity in the construction industry as these alloys are used in plumbing fittings, heating and air conditioning components, and other products. The addition of zinc to copper alloys improves their machinability, strength and resistance to corrosion.

The third most important use of zinc, accounting for 14% of all uses, is in zinc-based alloys for the creation of die-cast products such as builders' hardware and automobile fittings. The goal of weight reduction in automobiles for increased fuel efficiency has led to a reduction in the use of zinc die castings, although in the last few years zinc-based alloys have regained some of their former market share. The major reasons for this have been the development of direct injection die castings, the popularity of zinc-aluminum die-casting alloys, and diversification away from over-reliance on the automotive sector.

One promising series of alloys is ACuZinc, which contains 5-11% copper and 2.8-4.0% aluminum, with the balance being zinc. These alloys increase the durability and performance, and reduce the thickness, of automotive die castings compared to many other zinc alloys.

Zinc semi-manufactures represent about 8% of zinc use and include rolled zinc for roofing applications and the production of coinage. Rolled zinc roofing is especially popular in Europe.

The remainder of zinc usage is for oxides and other chemicals and zinc dust. Zinc oxide has a variety of applications, the most important of which is as an accelerator in the curing of rubber. High-purity zinc oxide is used in the pharmaceutical industry and zinc oxide-based salves and ointments have long been known for their healing properties. Other grades are used in the zinc plating industry, as an anti-corrosion agent in lubricants, and in paints, animal feeds and a variety of chemicals.

Zinc-air batteries are a promising development in the race to create viable electric vehicles. The zinc-air battery has a range three to four times that of comparatively sized lead-acid batteries. Its slow recharge time can be overcome by the introduction of replaceable cassettes that house a zinc anode and two cathodes that extract oxygen from air to fuel the chemical reaction. When removed, these cassettes can be taken to a regeneration facility where electrowinning cells turn zinc oxide back into zinc. Such a system is ideal for fleet vehicles that return to a centralized location each day, but for passenger vehicles the plan requires considerable infrastructure.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

The International Lead and Zinc Study Group was formed in 1959 to improve market information and to provide opportunities for regular inter-governmental consultations on issues related to lead and zinc markets. Particular attention is given to providing regular and frequent information on supply, demand and the outlook for lead and zinc.

The Study Group is headquartered in London, England. In 2000, 28 countries, representing most of the world's major lead- and zinc-producing and using nations, were members of the Group. The Group has an extensive information-gathering and dissemination role and acts as an effective mechanism for increasing market transparency related to lead and zinc production, use and trade. The Group is also an important forum for communication among governments, among industry, and between governments and industry. It holds a general session each year in October. Member countries' delegations include industry representatives as advisors. Canada has been an active member of the Group since its inception.

The 45th Session of the Study Group, chaired by Mr. Alek Ignatow of Canada, was held in London, England, in October 2000 and was attended by some 250 registered participants, including representatives of 26 member countries and observers from several invited nations, industry and non-governmental organizations. Delegates elected a new Secretary General, Mr. Don Smale of Australia, to replace Mr. Francis Labro of France, who retired as Secretary General at the end of the year. The next annual meeting of the Group will take place October 16-18, 2001, in New Delhi, India.

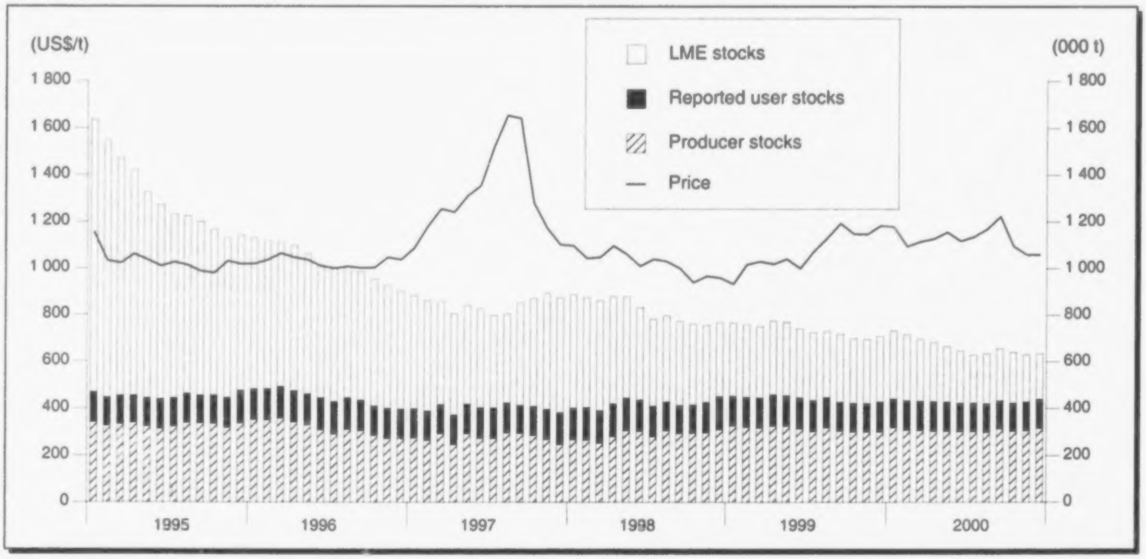
The Group continued to work on updating its capacity to deliver, through electronic means, its monthly statistical bulletin. It is now expected that the bulletin will be available to member countries and subscribers through the Group's web site by mid-2001.

More information about the Group's activities and the availability of a wide range of publications pertaining to lead and zinc can be obtained from its web site at www.ilzsg.org. For information on the Group's activities in partnership with the International Copper Study Group and the International Nickel Study Group related to the contribution nonferrous metals make to sustainable development and the Consultative Forum, visit these groups' joint web site at www.nfmsd.org.

PRICES AND STOCKS

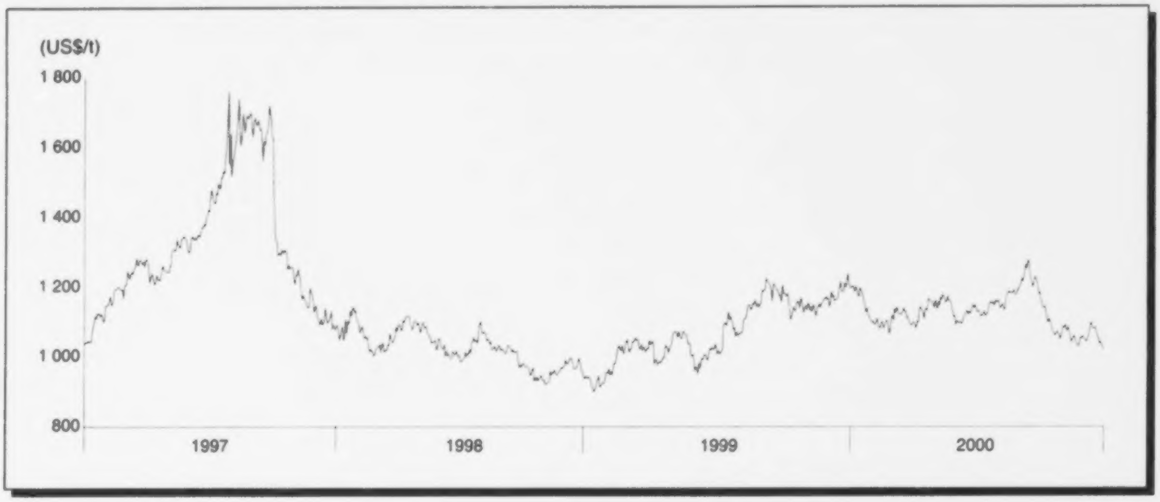
The LME Cash Settlement prices for zinc followed a downward trend in the first quarter of 2000. Cash prices started the year at US$1200/t and fell to $1065/t by the end of February, only to rally to reach a peak of US$1277/t in September before falling back to finish the year at its lowest value for the year of US$1021/t. The overall cash settlement price averaged US$1128.11/t in 2000, up 4.7% over 1999. The forward three-month price averaged US$1137.34/t, an increase of 4%. Higher prices reflected the strong demand in North America and the continued downward trend in stock levels. Stocks on the LME fell from a peak of 291 975 t in early February to a low of 194 250 t towards the end of the year. This represents just less than five weeks of Western World demand (Figures 8 and 9).

Figure 8
LME Monthly Average Settlement Prices and Total Stocks, 1995-2000



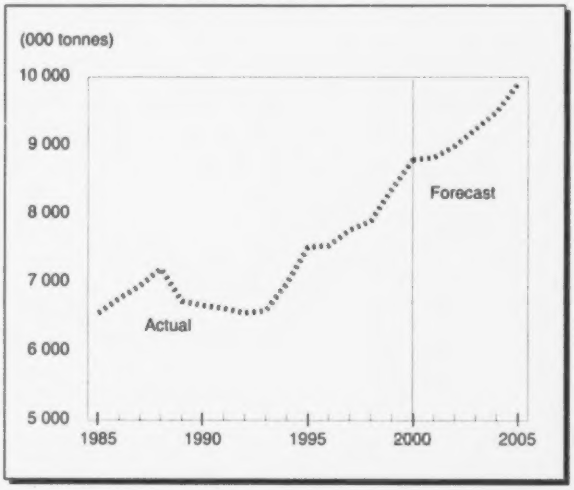
Source: International Lead and Zinc Study Group.

Figure 9
LME Daily Official Cash Settlement Prices, 1997-2000



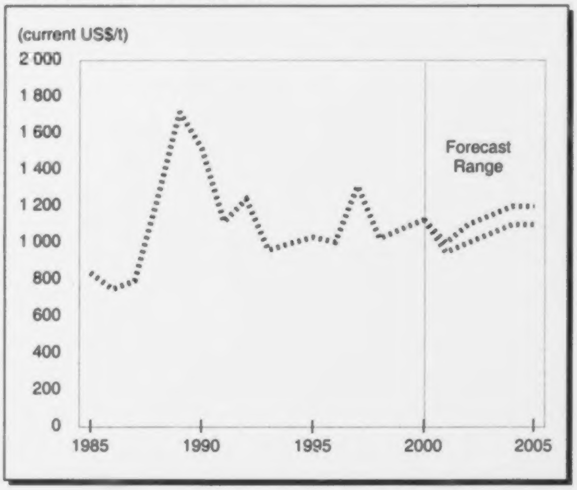
Source: London Metal Exchange.

Figure 10
World Zinc Use, 1985-2005



Source: International Lead and Zinc Study Group.

Figure 11
Average Cash Settlement Zinc Prices, 1985-2005
Annual LME Settlement



Source: Natural Resources Canada.

OUTLOOK

For 2001, the zinc market, according to information gathered by the member countries of ILZSG, is expected to result in a substantial Western World market surplus if ambitious production targets are achieved. Market demand is expected to weaken, particularly in the United States, while zinc metal output in 2001 is expected to increase 3.7%. Prices will likely reflect this potential oversupply and average about US$950/t (US43¢/lb) for the year.

Beyond 2001, investments made in the zinc industry in recent years are expected to result in large increases in mine and smelter capacity. Continued growth in galvanizing markets, combined with a gradual recovery in overall markets, is expected with zinc prices rising to US$1100-$1200/t by 2005 (Figures 10 and 11).

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of July 9, 2001. (3) This and other reviews, including previous editions, are available on the Internet at http//www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States	EU[1]	Japan[2]
		MFN	GPT	USA	Canada	MFN	WTO
2603.00	Copper ores and concentrates						
2603.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2607.00	Lead ores and concentrates						
2607.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2608.00	Zinc ores and concentrates						
2608.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2616.10	Silver ores and concentrates						
2616.10.00.30	Zinc content	Free	Free	Free	Free	Free	Free
26.20	Ash and residues (other than from the manufacture of iron or steel) containing metals or metal compounds containing mainly zinc						
2620.11	Hard zinc spelter	Free	Free	Free	Free	Free	Free
2817.00	Zinc oxide; zinc peroxide	Free-7.5%	Free	Free	Free	7.7%	4.3%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
2833.26	Of zinc	Free	Free	Free	Free	5.5%	3.9%
79.01	Unwrought zinc						
	Zinc, not alloyed:						
7901.11	Containing by weight 99.99% or more of zinc	Free	Free	Free	Free	2.5%	4.30 yen/kg
7901.12	Containing by weight less than 99.99% of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7901.20	Zinc alloys:						
7901.20.00.10	Containing by weight 90% or more but less than 97.5% of zinc	Free	Free	Free	Free	2.5%	4.30 yen/kg
7901.20.00.20	Containing by weight less than 90% of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7902.00	Zinc waste and scrap	Free	Free	Free	Free	Free	Free
79.03	Zinc dust, powders and flakes						
7903.10	Zinc dust	Free	Free	Free	Free	2.5%	3%
7903.90	Other:	Free	Free	Free	Free	2.5%	3%
7904.00	Zinc bars, rods, profiles and wires	Free	Free	Free	Free	5%	3%
7905.00	Zinc plates, sheets, strip and foil	Free	Free	Free	Free	5%	3%
7906.00	Zinc tubes, pipes, and tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5%	3%
7907.00	Other articles of zinc						
7907.00.10	Anodes for electroplating	Free	Free	Free	Free	5%	3%
7907.00.20	Discs or slugs, containing by weight 90% or more of zinc; gutters, roof capping, skylight frames and other fabricated building components	3%	Free	Free	Free	5%	3%
7907.00.90	Other	3%	3%	Free	Free	5%	3%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (40th Annual Edition: 2000); *Customs Tariff Schedules of Japan*, 2000.
[1] Duty suspension may apply for certain goods. [2] WTO rate is shown; lower tariff rates may apply circumstantially.
Note: Where there is a tariff "range," a complete match of the HS code was not available; therefore, the high and low for the product in question are shown.

TABLE 1. CANADA, ZINC PRODUCTION AND TRADE, 1999 AND 2000, AND USE 1997-99

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION					
	All forms[1]				
	Newfoundland	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	283 925	453 996	237 535	397 871
	Quebec	184 303	294 700	197 928	331 529
	Ontario	86 028	137 558	85 365	142 986
	Manitoba	86 911	138 970	80 929	135 557
	Saskatchewan	315	503	1 033	1 731
	Alberta	–	–	–	–
	British Columbia	126 170	201 745	147 710	247 415
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Nunavut	195 670	312 877	185 185	310 184
	Total	963 321	1 540 350	935 686	1 567 274
	Mine output[2]	1 020 982	. .	994 589	. .
	Refined[3]	776 927	. .	787 527	. .
EXPORTS					
2608.00.30	Zinc content in zinc ores and concentrates				
	Belgium	81 280	90 991	75 089	88 030
	Sweden	46 895	80 057	46 629	80 477
	Finland	25 883	43 885	45 797	65 902
	Spain	43 234	45 609	31 398	35 453
	Japan	13 476	9 024	34 892	33 305
	Italy	12 012	17 266	15 246	23 704
	Other countries	104 145	120 613	54 682	64 787
	Total	326 925	407 445	303 733	391 658
2603.00.30	Zinc content in copper	737	500	7 757	5 599
2607.00.30	Zinc content in lead	–	–	–	–
2616.10.30	Zinc content in silver	–	–	–	–
2620.11	Ash and residues containing hard zinc spelter				
	India	–	–	21	15
	United States	175	280	–	–
	Total	175	280	21	15
2620.19	Ash and residues containing mainly zinc, n.e.s.				
	United States	9 311	8 850	7 838	7 277
	South Africa	–	–	102	124
	India	164	152	84	82
	Other countries	42	40	40	42
	Total	9 517	9 042	8 064	7 525
2817.00	Zinc oxide; zinc peroxide				
	United States	35 857	58 213	44 007	72 848
	France	206	320	73	442
	Italy	–	–	331	423
	Norway	54	86	238	410
	Other countries	88	158	1 037	1 103
	Total	36 205	58 777	45 686	75 226
2833.26	Zinc sulphate				
	United States	48	117	23	41
	Total	48	117	23	41
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc				
	United States	363 869	610 579	350 299	631 763
	Taiwan	11 143	18 127	6 287	10 871
	Malaysia	5 245	8 309	4 864	8 651
	Hong Kong	2 503	4 114	4 174	7 397
	Singapore	4 180	6 814	3 386	5 969
	Philippines	4 878	7 604	3 675	6 267
	Indonesia	5 094	8 265	2 985	5 201
	Other countries	3 052	4 915	1 052	1 821
	Total	399 964	668 727	376 722	677 940

TABLE 1 (cont'd)

Item No.		1999		2000p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc				
	United States	179 259	299 865	187 166	332 883
	Hong Kong	4 806	8 797	9 064	17 491
	Taiwan	3 899	6 748	7 877	14 119
	Indonesia	1 859	3 275	4 799	8 772
	Other countries	21 006	35 457	16 960	29 202
	Total	210 829	354 142	225 866	402 467
7901.20	Zinc alloys, unwrought				
	United States	574	1 111	1 734	3 345
	Total	574	1 111	1 734	3 345
7902.00	Zinc waste and scrap				
	United States	24 335	18 399	33 547	22 705
	Taiwan	1 052	1 172	2 400	2 366
	India	100	91	386	292
	Other countries	41	47	61	66
	Total	25 528	19 709	36 394	25 429
7903.10	Zinc dust				
	United States	6 242	14 151	5 287	12 915
	South Africa	–	–	41	49
	Other countries	15	23	21	50
	Total	6 257	14 174	5 349	13 014
7903.90	Zinc powders and flakes				
	United States	7 251	19 816	8 339	24 466
	Other countries	326	540	587	1 038
	Total	7 577	20 356	8 926	25 504
7904.00	Zinc bars, rods, profiles and wire				
	United States	93	593	152	679
	Other countries	2	10	–	–
	Total	95	603	152	679
7905.00	Zinc plates, sheets, strip and foil				
	United States	19	104	10	99
	Other countries	18	78	–	–
	Total	37	182	10	99
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)				
	United States	1 610	11 567	1 176	8 084
	Other countries	–	–	2	36
	Total	1 610	11 567	1 178	8 120
7907.00	Other articles of zinc				
	United States	2 763	20 941	3 644	24 443
	Other countries	14	99	78	273
	Total	2 777	21 040	3 722	24 716
	Total exports		1 587 772		1 661 377
IMPORTS					
2608.00.00.30	Zinc content in zinc ores and concentrates	266 455	130 596	207 676	128 115
2603.00.00.30	Zinc content in copper ores and concentrates	3	3	3	3
2607.00.00.30	Zinc content in lead ores and concentrates	1 165	999	3 149	2 614
2616.10.00.30	Zinc content in silver ores and concentrates	37 798	30 781	20 889	17 275
2620.11	Ash and residues containing hard zinc spelter	4	5	25	46
2620.19	Ash and residues containing mainly zinc, n.e.s.	1 050	853	1 518	1 767
2817.00	Zinc oxide; zinc peroxide	5 772	7 669	7 521	10 525
2833.26	Zinc sulphate	4 415	3 179	5 659	3 954
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc	2 425	3 789	3 153	5 267
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc	1 597	2 399	3 484	5 516
7901.20	Zinc alloys, unwrought	8 354	15 544	7 870	15 194

TABLE 1 (cont'd)

Item No.		1999		2000[p]	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7902.00	Zinc waste and scrap	831	747	408	393
7903.10	Zinc dust	3 632	7 425	5 019	10 307
7903.90	Zinc powders and flakes	369	587	588	1 191
7904.00	Zinc bars, rods, profiles and wire	8 483	13 983	8 664	15 315
7905.00	Zinc plates, sheets, strip and foil	1 038	2 940	1 124	4 701
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)	1 911	11 484	1 771	12 369
7907.00	Other articles of zinc	5 815	23 974	7 285	28 699
	Total imports		256 957		263 251

	1997			1998[a]			1999[pa]		
	Primary	Recycled	Total	Primary	Recycled	Total	Primary	Recycled	Total
					(tonnes)				
QUANTITY USED[5,6]									
Zinc used for or in the production of:									
Copper alloys (brass, bronze, etc.)	x	x	2 717	x	x	2 987	x	x	2 395
Galvanizing: electro	x	x	2 349	x	x	2 662	x	x	2 472
hot dip	x	x	77 034	x	x	76 208	x	x	75 716
Zinc die-cast alloys	x	x	20 747	x	x	27 402	x	x	29 550
Other products (including rolled and ribbon zinc, zinc oxides)	x	x	30 706	x	x	29 164	x	x	33 055
Total	131 035	2 518	133 553	137 610	814	138 424	142 451	737	143 188
User stocks, year-end	10 133	65	10 198	8 994	59	9 053	12 175	89	12 264

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; [p] Preliminary; x Confidential.
[a] Increase in number of companies being surveyed.
[1] New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. [2] Zinc content of ores and concentrates produced. [3] Refined zinc produced from domestic and imported ores. [4] Includes HS classes 2603.00.30, 2607.00.30 and 2616.10.30. [5] User survey does not represent all Canadian users and is therefore consistently less than the apparent quantity used. [6] Due to confidentiality in some end-use categories, a breakdown of primary and recycled sources is not provided in order to be consistent.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ZINC PRODUCTION AND EXPORTS,[1] 1975, 1980 AND 1986-2000

	Production		Exports		
	All Forms[2]	Refined[3]	In Ores and Concentrates	Refined	Total
			(tonnes)		
1975	1 055 151	426 902	705 088	247 474	952 562
1980	883 697	591 565	434 178	471 949	906 127
1986	988 173	570 981	450 249	427 176	877 425
1987	1 157 936	609 909	613 185	441 227	1 054 412
1988	1 370 000	703 206	816 885	551 521	1 368 406
1989	1 272 854	669 677	614 223	495 061	1 109 284
1990	1 179 372	591 786	716 185	452 251	1 168 436
1991	1 083 008	660 552	566 815	520 508	1 087 323
1992	1 195 736	671 702	678 172	509 744	1 187 916
1993	990 727	659 881	455 953	493 264	949 217
1994	976 309	690 965	450 320	551 168	1 001 488
1995	1 094 703	720 346	609 575	533 179	1 142 754
1996	1 162 720	716 467	670 789[r]	581 604	1 252 393[r]
1997	1 026 864[r]	703 798[r]	489 697[r]	546 964[r]	1 036 661[r]
1998	991 584	745 131	425 341	576 926	1 002 267
1999	963 321	776 927	327 662	610 793	938 455
2000[p]	935 686	787 527	311 490	602 588	914 078

Sources: Natural Resources Canada; Statistics Canada.
[p] Preliminary; [r] Revised.
[1] Beginning in 1988, exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2608.00.30, 2603.00.30, 2607.00.30 and 2616.10.30. Refined includes HS classes 7901.11 and 7901.12. [2] New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. [3] Refined zinc produced from domestic and imported ores.

TABLE 3. WESTERN WORLD, PRIMARY ZINC STATISTICS, 1996-2000

	1996	1997	1998	1999	2000p
			(000 tonnes)		
Mine production (zinc content)	5 565	5 495	5 657	5 857	6 240
Metal production	5 509	5 582	5 718	5 834	6 161
Metal used	6 238	6 429	6 524	6 712	6 976

Source: International Lead and Zinc Study Group.
p Preliminary.

TABLE 4. WORLD MINE PRODUCTION OF ZINC, 1996-2000

	1996	1997	1998	1999	2000p
			(000 tonnes)		
EUROPE					
Finland	27	32	31	20	16
Ireland	163	193	180	200	263
Poland	159	158	160	148	148
Russia	126	121	114	132	136
Spain	140	147	128	154	204
Sweden	160	155	161	175	177
Others	123	119	106	97	77
Subtotal	898	925	880	926	1 021
AFRICA					
Morocco	82	90	112	112	110
Namibia	35	37	42	35	40
South Africa	77	71	70	70	63
Others	38	10	33	51	47
Subtotal	232	208	257	268	260
OCEANIA					
Australia	1 008	972	1 020	1 110	1 380
AMERICAS					
Bolivia	145	154	151	145	144
Brazil	128	124	88	96	93
Canada	1 223	1 077	1 062	1 021	997
Mexico	378	379	395	354	384
Peru	761	868	869	900	910
United States	628	632	755	843	824
Others	103	107	88	106	109
Subtotal	3 366	3 341	3 408	3 465	3 461
ASIA					
China	1 121	1 210	1 273	1 476	1 710
India	154	142	195	185	208
Iran	76	77	82	79	80
Japan	79	72	68	64	64
Kazakstan	157	223	224	288	322
North Korea	80	60	44	37	34
Thailand	19	15	25	24	27
Turkey	68	64	58	57	48
Others	38	28	29	32	28
Subtotal	1 792	1 890	1 998	2 242	2 521
Total world	7 296	7 337	7 563	8 009	8 643
Total Western World	5 565	5 495	5 687	5 857	6 240

Source: International Lead and Zinc Study Group.
p Preliminary.

TABLE 5. WORLD ZINC METAL PRODUCTION,[1] 1996-2000

	1996	1997	1998	1999	2000p
			(000 tonnes)		
EUROPE					
Belgium	207	203	205	232	264
Finland	179	176	199	225	223
France	324	317	320	318	318
Germany	362	348	361	361	357
Italy	269	268	232	145	170
Netherlands	207	203	217	221	217
Norway	135	136	138	144	138
Poland	163	171	175	180	174
Russia	172	189	192	221	222
Spain	363	378	385	383	391
Others	277	289	265	252	263
Subtotal	2 658	2 678	2 689	2 682	2 737
AFRICA					
Algeria	30	30	31	32	33
South Africa	101	110	107	108	103
Others	–	–	–	–	–
Subtotal	131	140	138	140	136
AMERICAS					
Argentina	36	39	39	40	36
Brazil	187	186	177	187	195
Canada	716	704	745	777	780
Mexico	222	230	229	219	245
Peru	173	173	184	191	200
United States	366	366	368	372	400
Subtotal	1 700	1 698	1 741	1 785	1 856
ASIA					
China	1 185	1 434	1 486	1 703	1 919
India	149	166	180	189	204
Japan	599	603	608	633	654
Kazakstan	169	185	240	243	262
South Korea	287	335	390	430	477
Thailand	73	84	89	95	101
Others	164	152	148	116	89
Subtotal	2 626	2 959	3 141	3 409	3 706
OCEANIA					
Australia	327	307	311	344	493
Total world	7 442	7 783	8 021	8 361	8 928
Total Western World	5 509	5 583	5 719	5 834	6 161

Source: International Lead and Zinc Study Group.
– Nil; p Preliminary.
[1] Total production by smelters and refineries of zinc in marketable form or used directly for alloying, including production on toll in the reporting country, regardless of the type of source material from which it is produced, i.e., whether ores, concentrates, residues, slag or scrap. Remelted zinc and zinc dusts are excluded.

TABLE 6. ZINC USE,[1] BY COUNTRY AND BY REGION, 1996-2000

	1996	1997	1998	1999	2000p
			(000 tonnes)		
EUROPE					
Belgium	235	260	260	275	285
France	248	271	285	298	310
Germany	501	530	573	561	530
Italy	336	354	373	336	377
Russia	130	146	110	120	119
Spain	150	160	197	190	203
United Kingdom	226	224	219	220	210
Others	597	628	625	607	648
Subtotal	2 423	2 573	2 642	2 607	2 682
AFRICA					
South Africa	95	98	91	87	90
Others	60	57	62	68	72
Subtotal	155	155	153	155	162
OCEANIA					
Australia	177	183	192	210	217
New Zealand	20	18	17	15	17
Subtotal	197	201	209	226	233
AMERICAS					
Brazil	185	190	177	187	192
Canada	151	161	170	169	176
Mexico	152	178	186	200	212
United States	1 210	1 243	1 313	1 342	1 358
Others	151	150	156	162	159
Subtotal	1 849	1 922	2002	2 060	2 097
ASIA					
China	829	830	920	1 200	1 350
India	214	220	232	254	270
Japan	736	742	659	634	676
South Korea	364	343	318	389	438
Taiwan	194	225	241	273	294
Others	589	556	523	568	596
Subtotal	2 926	2 916	2 893	3 318	3 624
Total world	7 550	7 767	7 900	8 366	8 798
Total Western World	6 238	6 429	6 524	6 712	6 976

Source: International Lead and Zinc Study Group.

p Preliminary.

[1] Total refined zinc use, including zinc used directly for the production of zinc alloys, regardless of the type of source material from which produced, i.e., ores, concentrates, residues, slags or scrap. Remelted zinc and zinc dusts are excluded.

TABLE 7. CANADA, ZINC METAL CAPACITY, 2000

Company and Location	Annual Rated Capacity
	(000 tonnes of slab zinc)
PRIMARY	
Canadian Electrolytic Zinc Limited Valleyfield, Quebec	250
Falconbridge Limited Timmins, Ontario	133
Hudson Bay Mining and Smelting Co., Limited Flin Flon, Manitoba	95
Cominco Ltd. Trail, British Columbia	290
Total primary, Canada	768

Source: Natural Resources Canada.

TABLE 8. MONTHLY AVERAGE ZINC PRICES, 1999 AND 2000

	LME Special High Grade Settlement
	(US$/t)
1999	
January	932.7
February	1 017.3
March	1 030.0
April	1 019.0
May	1 040.7
June	1 000.5
July	1 072.1
August	1 130.6
September	1 193.7
October	1 148.7
November	1 147.2
December	1 183.7
Yearly average	1 077.3
2000	
January	1 178.8
February	1 094.2
March	1 116.4
April	1 127.6
May	1 156.8
June	1 117.9
July	1 136.2
August	1 169.8
September	1 224.4
October	1 095.9
November	1 059.1
December	1 059.8
Yearly average	1 128.1

Source: International Lead and Zinc Study Group.

Canada's Rank in World Mining

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INTRODUCTION

For years, Canada has consistently been one of the world's major non-petroleum mineral-producing countries. Until now, there has been no way of knowing Canada's exact ranking in the world production hierarchy or the ranking of any of the world's other major mineral producers.

In 1998, an initial ranking of the world's mineral-producing countries and other jurisdictions in terms of their 1996 value of production of non-petroleum minerals was undertaken. In mid-2001, a decision was made to partially repeat this analysis for 1998, the most recent year for which mineral production statistics for the world's countries (and other mineral-producing jurisdictions) were then readily available. To determine the top 25 countries in 1998, rankings of production values were calculated for the top 30 countries from 1996. Also, production tonnages in 1998 of the major commodities produced by those countries that had ranked 31 to 40 in 1996 were compared with 1996 tonnages to ensure that there had been no major production increases that might have moved any of them into the top 25 in 1998.

SOURCES OF PRODUCTION DATA

Two principal sources of mineral commodity production data were used in this analysis: the British Geological Survey (BGS) publication entitled *World Mineral Statistics 1992-96* and a subsequent edition, *World Mineral Statistics 1995-99*, and the U.S. Geological Survey's (USGS) *Minerals Yearbook*, Volume III for 1996 (and subsequently the one for 1998).

The BGS publication provides annual data concerning production of some 70 metals, ores, industrial minerals, coal, petroleum and natural gas for all of the world's countries and other mineral-producing jurisdictions (French Guiana, New Caledonia and Netherlands Antilles). Most of the tonnages published by the BGS are internationally approved statistics that have been discussed and accepted by the International Consultative Group on Nonferrous Metals Statistics. The BGS does not cover all mineral commodities. For example, it does not cover most of the mineral commodities used for construction purposes, such as cement, lime, aggregates and dimension stone, nor does it cover gemstones other than diamonds, or many of the industrial mineral commodities, such as sodium carbonate, sodium sulphate, mineral pigments, abrasive minerals, peat, pumice and silica.

The production of commodities not covered by the BGS was obtained from USGS country reports. For both 1996 and 1998, production statistics for the United States were obtained from the USGS's *Minerals Yearbook*, Volume I.

COUNTRY OF ORIGIN OF BY-PRODUCT COMMODITIES

Certain elements (cadmium, mercury, rhenium, germanium, selenium, tellurium, silver, gold, other precious metals, and possibly cobalt) are not necessarily recovered in metallic form in the countries where they are mined, but are recovered instead at smelters/refineries in countries with little or no mine production of metals. The actual mine sources of such metals are located in the mining countries from which the concentrates have been imported. In the concentrates, the recovered metals may have been present only in trace quantities that were neither analyzed for nor paid for in purchasing those concentrates. Because the actual origin of these metals is not known in any quantitative fashion, "mine" production of such by-products has been assigned by the BGS to the countries in which the smelters or refineries are located. For example, neither Belgium nor the Netherlands have any metal mines, yet 1996 "mine" production of cadmium from zinc plants located in those countries was 1580 t in Belgium and 603 t in the Netherlands. Similarly, Japanese cadmium production of 2344 t and German cadmium production of 950 t probably came chiefly from imported zinc concentrates. The 250 t of selenium reported as being produced by Belgium, the 58 t of selenium credited to Japan, and the 40 t of tellurium reported as being Japanese production were also recovered chiefly from imported copper concentrates. Similarly, the 2 t of germanium recovered in Japan and unknown quantities of gold and silver recovered as by-products in various countries have all been recovered from concentrates that originated in other countries.

MINERAL COMMODITY VALUES

Introduction

There are several methods by which the annual value of a country's mineral production can be calculated and compared. One method is to obtain official government statistics concerning mineral production value for all mineral commodities for each and every of the world's many countries, quoted in the currencies of each country, and then use average annual currency exchange rates (difficult or almost impossible to obtain for many countries) to transform all of these into a single currency, such as U.S. dollars. There are several problems with such an approach.

First, one must locate the sources of such production statistics (tonnages and values) for all of the world's countries, which would be difficult. Second, there would also be language translation-related difficulties. Third, countries have various ways of calculating production values – some use mine-gate production values, such as the value of copper concentrates f.o.b. (free on board) a mine, while others use more highly processed values, such as the market value of the refined copper produced, and still others use export values that include the cost of shipping minerals to a seaport and loading them onto a ship (f.o.b.). Fourth, converting production values in domestic currencies into an internationally valued currency such as the U.S. dollar can create problems, especially if currency exchange rates are at controlled official rates of exchange that have little relationship to the real value of the currency. Fifth, varying exchange rates are another difficulty. For example, between January 1997 and August 1999, the value of the Canadian dollar declined from US$0.7415 to US$0.6513, which would have resulted in an apparent decline in the value of Canada's mineral production of some 12%, even if the volume of Canadian mineral production tonnages had remained constant.

Approach Used in This Analysis

In this analysis, a standard set of mineral commodity prices was applied worldwide to the tonnage of production of each mineral in each country. For some commodities in certain countries, this methodology may have yielded values of production considerably in excess of official production values, but it has provided an appropriate and workable method of comparing the mineral production of all the world's countries, which is why it has been used here.

Mineral Commodity Prices

There are a variety of different price quotes available for most mineral commodities, e.g., for concentrates at the mine (which exclude the costs of shipping, smelting and refining), and one or more metal market prices, such as the London Metal Exchange (LME) price or the New York Commodity Exchange prices (which are not exactly the same) for most refined metals (both of which include the costs of smelting and refining).

Some prices, such as LME prices, are for metal physically located in LME warehouses at various world locations with removal and shipping costs being the responsibility of the purchaser. North American producer prices generally include the costs of shipment to the customer in railway carload lots.

Many of the so-called "industrial minerals" come in differing grades or degrees of fineness of grind. The degree of fineness can range from crude lump material to material ground to minus 400 mesh, or finer. Generally, the finer the grind, the higher the price. They can be "bulk" (unpackaged), or packaged in bags or in drums, with the packaged forms more expensive than bulk quantities. Prices for various grades and fineness of grind differ, and prices can be quoted f.o.b. a railway car, a truck at the mine, or a ship at an ocean port; delivered to a foreign port, c.i.f. (cost, insurance and freight included in the price); at a foreign port f.a.s. (free alongside ship); f.o.t. (free on truck), delivered to the purchaser in a domestic or foreign country; and so on.

Many industrial minerals come in differing degrees of purity, sometimes expressed in percentages, such as graphite 92/95% C, 85/90% C; fluorspar, metallurgical grade 85% CaF_2, acidspar 97% CaF_2; phosphate 75-77% BPL (bone phosphate of lime), 70-72% BPL; manganese, battery grade 78-85% MnO_2, chemical grade 74-84% MnO_2; and so on.

Coal prices are generally quoted either f.o.b. a mine or f.o.b. an appropriate ocean port.

COMMODITY PRICES USED IN THIS ANALYSIS

In this analysis, for metal prices, LME prices have generally been used for the metals that are traded on the LME, rather than producer prices (which include shipping costs); London market prices have been used for gold, platinum, palladium; and dealer prices have been used for the specialty metals such as cadmium, mercury, and the less common precious metals such as rhodium, iridium, ruthenium and osmium. For the various industrial minerals, prices f.o.b. a mine or plant have been used where such prices were available. If this was not possible, prices f.o.b. producing countries have been used.

For coal, prices for clean coal f.o.b. mine have been used, rather than f.o.b. an ocean port. The intent has been to eliminate or at least minimize the inclusion of freight costs for shipping the mineral commodity from where it is produced to the consumer.

PRICE SOURCES

Introduction

There is no one source for the prices of all mineral commodities. Metals such as aluminum, copper, gold, nickel, platinum, palladium, tin, zinc and others are traded daily on metal exchanges, such as the LME, so that daily metal exchange prices can be averaged to provide approximate annual average prices. For the major metals, annual average prices are available from the weekly publication *Platts Metals Week*. For a very few rare metals, annual averages have had to be calculated using data concerning prices and dates of price changes reported in *Metal Bulletin*. Prices for many of the industrial minerals appear monthly in the periodical *Industrial Minerals*, so that the 12 monthly prices quoted in this publication can be averaged to yield approximate annual average prices. There is generally more than one price quote for a particular mineral commodity, obtainable from several world sources, and sometimes for different degrees of purity or different grades. For some of these minerals, such as talc and wollastonite, the price is higher for more finely ground material. Asbestos has multiple grades with widely different prices, based chiefly on fibre length. In general, prices applicable to bulk lump or coarsely ground industrial minerals have been used rather than those for finely ground minerals, and also prices as close to the mine mouth as possible have been used in order to eliminate freight costs. Where two prices for apparently similar material differ, or where a price range is all that is available, an average of the two prices, or of the lower and upper prices of a price range, has usually been used.

Prices for construction materials, such as cement, lime, sand, gravel, crushed rock aggregates and the like, are not generally available from published sources. Furthermore, sand, gravel and crushed rock aggregate prices are generally based on a price f.o.b. the pit or quarry plus a charge for delivery that is dependent on the distance these commodities have to be transported to the consumer. The source for prices used in the present analysis for such construction materials has been the USGS publication *Mineral Commodity Summaries 1997*, published in February 1997, which lists the estimated 1996 U.S. production of each commodity and average U.S. prices in that year in dollars per metric tonne. Similarly, prices for 1998 were obtained from *Mineral Commodity Summaries 1999*. These prices have been applied to the production of all countries.

Prices for salt, asbestos and gypsum were obtained from the 1996 and 1998 editions of the *Canadian Minerals Yearbook*. For uranium, the 1996 and 1998 "restricted prices" were obtained from Natural Resources Canada's Energy Sector. In the case of iron ore, the U.S. f.o.b. mine prices given in the USGS's *Mineral Commodity Summaries* were inappropriate because they were more than double the world iron ore price. The iron ore prices used are based on the f.o.b. mine value of iron ore shipments from Canadian mines to customers in Europe (the Japanese tend to squeeze iron ore prices down below world averages so that the price of sales to Europe is more appropriate).

There is wide variation in world sulphur prices. Canadian sulphur is produced by the removal of H_2S gas from "sour" natural gas. After the deduction of freight costs to the port of Vancouver, some of that sulphur has a negative value at the producing plant stockpile, i.e., it is not worth shipping so it remains in the stockpile until higher prices make shipment worthwhile. The price for sulphur f.o.b. a U.S. mine or plant (US$38/t in 1996) has been used. This exceeds the average Canadian price f.o.b. Vancouver, a price that includes rail freight to Vancouver. During 1996, the f.o.r. (free on rail) Alberta producing plant price for liquid sulphur was in the range of US$2-$15/t.

Coal prices suitable for this analysis are difficult to obtain. Many producers tend to consider the prices at which they sell their coal to be confidential and have agreements with their customers that require price confidentiality. Shipping costs, coal rank and the heat content type of coal (metallurgical versus steam), and sulphur content are only some of the important factors. An example of the influence of shipping costs is provided by the price of marketable bituminous coal produced in Nova Scotia; in 1996, this coal sold at an average mine-mouth price equivalent to US$42.60/t when the mine-mouth price of comparable coal in the U.S. Appalachians was only US$24.00/t. The Nova Scotia producers were able to command the higher price because the price difference was roughly equal to the cost of hauling U.S. coal by rail to an ocean port and then by ship to Nova Scotia.

Similarly, coal used at Manitoba Hydro's two thermal power-peaking plants is chiefly sub-bituminous coal hauled by rail from Montana, with freight costs roughly double the mine-mouth price paid for the coal in Montana. Lignite coal could easily be obtained from less distant mines in southeastern Saskatchewan, but the lignite has a considerably lower heat content and also a higher per-tonne price, so it is less economical than the coal from mines in Montana. The most important factors to consider in the purchase of coal are: 1) delivered cost per BTU or per kilogram calorie; 2) the sulphur content of the coal; and 3) the suitability of the coal for the planned use.

In some countries, coal production costs are highly subsidized by governments so these costs can be as much as several times the world market price for comparable coal. To use subsidized prices in comparing mineral production values seems inappropriate, so they have not been used in this analysis.

The definition of exactly what coals constitute anthracite, bituminous, sub-bituminous, lignite and brown coal appears to depend to a considerable extent on the particular expert who defines them. Although anthracite is a higher rank coal (90-97% carbon by one definition) than bituminous coal (85-90% carbon by the same set of definitions), the higher hydrocarbon content in bituminous coals also provides combustion heat, so there is little difference in heat content and, as a result, little difference in the market prices of anthracite and bituminous coal. Therefore, in the present analysis, the same price has been used for both anthracite and bituminous coal. Useable price information for "brown coal" has been impossible to obtain, so an arbitrary assumption has been made that it has a price of US$1.00/t lower than the price of lignite. Similarly, for peat fuel, used in a few countries, an arbitrary price that is US$2.00/t lower than the price of lignite has been used.

The following are the average coal prices in U.S. dollars (f.o.b. mine) compiled for 1996 from all available sources and used in this analysis. Coal is widely available from North American coal mines at such prices, but neither brown coal nor peat fuel are produced in North America.

Type	Price
	(US$/t)
Bituminous and anthracite	24.00
Sub-bituminous	8.50
Lignite	7.00
Brown coal	6.00
Peat fuel	5.00

As there did not appear to have been any significant change in coal prices in 1998 from the 1996 prices, the same prices were used for the 1998 analysis.

Prices Used for the 1998 Production Ranking Analysis

For 1996, having to find and then average monthly and even daily prices for many mineral commodities was extremely time consuming. To shorten the task for 1998, published prices for such commodities at mid-year were used instead of annual price averages.

THE WORLD'S TOP 25 MINING COUNTRIES IN 1996 AND 1998

Table 1 lists the world's top 25 mining countries in 1996 and 1998, giving the calculated U.S. dollar value for the 1996 and 1998 non-petroleum mineral production of each country.

On first reflection, some of the world's major mineral-producing countries might not have been thought of as being major mining countries. This is because they are not significant mine producers of metals. Such countries include Germany, Japan, South Korea, Italy, the United Kingdom and France. These countries are important producers of non-petroleum minerals chiefly because of their large production of construction materials, the industrial minerals and, in some cases, coal used mostly for electric power generation and/or steel-making.

The production value ranking of countries changed from 1996 to 1998, not only because of higher or lower production of individual mineral commodities, but also because of the effects of changes from year to year in the prices of the mineral commodities that each country produces. It cannot be concluded that the volume of mineral production of individual countries has been higher or lower because production values, or country rankings, have changed from one year to the next. Because most construction materials are missing from the Chinese and Russian production value totals (presumably because the USGS has not been able to obtain these data), the actual value of China's total mineral production is considerably higher than shown in Table 1. Similarly, the value of Russia's total mineral production, including the missing construction materials, would almost certainly place Russia third in the world in terms of mineral production value, behind the United States but ahead of South Africa.

UNCERTAINTIES CONCERNING PRODUCTION STATISTICS AND MINERAL COMMODITY PRICES

Some of the production statistics and some of the prices that have been used in the analysis are not accurate final data. The BGS's 1996 production tonnages for some commodities, in some countries, were reported as being nil in the 1992-96 BGS report yet, with hindsight, the 1995-99 report indicates that there was production of some of those minerals in some of those countries during 1996. There were a considerable number of such omissions in the 1992-96 report. In many other cases, the production tonnages for some minerals in some countries for 1996 that were published in the 1992-96 BGS report have been subject to major revisions in the 1995-99 report. Similarly, many tonnages published by the BGS are reported as being estimates and there is no way to know the accuracy of those estimates.

Similar omissions and subsequent revisions for some mineral commodities, in certain countries, are found in the USGS production statistics. Especially in the case of nonmetallic mineral commodities, various countries report their production of certain commodities in ambiguous ways, for example, it is not clear whether reported tonnages of stone are of high-value dimension stone or of low-value crushed rock aggregate. In some cases, higher-value and lower-value forms of a commodity are combined in a single reported tonnage for a country, for example, a kaolin tonnage totaled together with a tonnage of common clay. This sort of reporting has forced a certain number of interpretations of which commodity price value to use. In general, in such cases, the price of the lower-valued commodity was used for the entire production tonnage reported, even though an unknown portion of the reported tonnage must have been higher-valued material.

There are also other statistical difficulties. For example, the BGS reports total carats of diamond production for all diamond-producing countries. Some of these diamonds are low-value industrial diamonds and the remainder are high-value, gem-quality diamonds. There is no way to know what average prices to apply to the BGS data to come up with a total value of each country's diamond production. The diamond production values were World Diamond Council estimates for the years 1997 and 1999, which had to be used in this analysis as proxies for the values of 1996 and 1998 diamond production, respectively, because the 1996 and 1998 values could not be found.

Another difficulty is the various grades of tonnages of the iron ore and the manganese ore that are produced in different countries. Those grades must be taken into account in ore value calculations. The BGS reported manganese grades for 1996 but not for 1998. The BGS did not report iron ore grades for either year, but a United Nations compilation of iron ore grades was available for 1996; that compilation has now been discontinued. So, with the unavailability of better data, the assumption was made that, in 1998, the grades of both iron ore and manganese ore production were identical to those for 1996.

Some data are incomplete, or unavailable, in certain of the USGS reports. For example, in the case of China, statistics concerning the production of construction materials are far from complete. The only Chinese construction materials production statistics reported by the USGS are those for cement and gypsum. There are no data for Chinese production of sand and gravel, crushed rock aggregates, dimension stone, or for common clay used for the manufacture of bricks and the like. A country with a population as exceptionally large as that of China must have a production value of these construction materials that totals several tens of billions of U.S. dollars annually, an amount that must exceed the value of Canada's production of all the non-petroleum mineral commodities combined.

Russia is the other country in the top 25 for which production statistics are not readily available for the construction materials (sand and gravel, crushed rock aggregates, dimension stone and common clay); the value of Russian production is therefore also significantly understated in the current analysis.

In addition, there are inaccuracies in the prices quoted for some of the nonmetallic mineral commodities covered by the USGS's *Mineral Commodity Summaries*. In recent editions, prices for some mineral commodities have been subjected to major revisions that go back several years. This means that a significant number of the prices that were used to calculate 1996 production values may have been incorrect; it was not feasible to go back and revise all the production value calculations for 1996. Similarly, it is possible that such revisions to 1998 prices may be made by the USGS in the future.

In conclusion, the country production value totals reported in Table 1 are only approximations.

VALUE OF MINERAL PRODUCTION PER CAPITA (TABLE 2), AND PER SQUARE KILOMETRE (TABLE 3)

Values of mineral production can be measured in ways other than the total value of production for each country (or other mineral-producing jurisdiction), such as in terms of values in dollars per capita and/or per square kilometre.

Production values per capita for the world's top 25 mineral-producing countries in 1996 are presented in Table 2. Of those 25 countries, Australia (US$928 per capita) ranked first, Canada (US$488 per capita) ranked third, and India (US$16 per capita) ranked twenty-fifth. There were another 70 countries/jurisdictions that had per-capita mineral production values lower than that of India.

Production values per square kilometre for the world's top 25 mineral-producing countries in 1996 were also calculated. Of the top 25 mineral-producing nations, Canada ranked twenty-second from the top (Table 3) with a value of mineral production per square kilometre of only US$1465, compared to South Korea with a production value of US$53 434 per square kilometre. Four countries/jurisdictions not among the world's top 25 mining countries (Nauru, Christmas Island, New Caledonia, and Belgium), have per-square-kilometre production values even higher than that of South Korea.

Canada's rank of twenty-second in terms of the value of production per square kilometre is a rank relative to those of only the world's top 25 mineral-producing countries. However, when all of the world's 189 countries and other non-country jurisdictions are considered, in 1996, Canada was a surprisingly low ninety-first from the top in terms of value of mineral production per square kilometre. There were 90 countries or jurisdictions in which the production value per square kilometre exceeded that in Canada.

Notes: (1) Information in this review was current as of December 31, 2000. (2) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html

NOTE TO READERS

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TABLE 1. VALUE OF NON-PETROLEUM MINERAL PRODUCTION OF THE WORLD'S TOP 25 PRODUCERS OF NON-PETROLEUM MINERALS IN 1996 AND 1998

1996			1998		
Rank	Country	Value	Rank	Country	Value
	(US$ millions)			(US$ millions)	
1	China[1]	78 749	1	China[1]	80 208
2	United States	58 626	2	United States	56 715
3	South Africa	17 991	3	South Africa	17 192
4	Australia	16 809	4	Russia[1]	17 039
5	Russia[1]	16 510	5	Australia	16 311
6	Canada	14 617	6	India	15 728
7	India	14 491	7	Canada	12 843
8	Brazil	9 910	8	Germany	10 226
9	Germany	9 390	9	Brazil	10 060
10	Japan	9 212	10	Japan	8 808
11	Chile	9 157	11	Chile	8 169
12	Mexico	6 977	12	Poland	7 260
13	Poland	6 704	13	Indonesia	6 722
14	Indonesia	6 050	14	Mexico	6 566
15	South Korea	5 290	15	Italy	6 416
16	Italy	5 233	16	Turkey	6 066
17	Peru	4 773	17	United Kingdom	4 397
18	United Kingdom	4 506	18	South Korea	4 338
19	Spain	4 426	19	Peru	3 856
20	Turkey	4 233	20	Spain	3 798
21	Kazakhstan	3 497	21	Iran	3 647
22	Iran	3 159	22	Ukraine	3 460
23	Ukraine	3 157	23	Kazakhstan	3 315
24	France	3 153	24	France	3 262
25	North Korea	2 467	25	North Korea	3 065

Sources: Natural Resources Canada.

[1] Totals for China and Russia exclude most construction materials because those data could not be obtained. The correct rank of Russia was almost certainly third in both 1996 and 1998, ahead of South Africa and Australia.

TABLE 2. VALUE OF NON-PETROLEUM MINERAL PRODUCTION PER CAPITA OF THE 25 COUNTRIES WITH THE HIGHEST VALUE OF NON-PETROLEUM MINERAL PRODUCTION IN 1996

Rank	Country	Production Value Per Capita
		(US$)
1	Australia	928
2	Chile	642
3	Canada	488
4	South Africa	409
5	United States	222
6	Kazakhstan	205
7	Peru	202
8	Poland	174
9	South Korea	117
10	Germany	115
11	Spain	112
12	Russia[1]	111
13	North Korea	103
14	Mexico	98
15	Italy	91
16	United Kingdom	77
17	Japan	74
18	Turkey	69
19	China[1]	64
20	Brazil	61
21	Ukraine	61
22	France	54
23	Iran	46
24	Indonesia	30
25	India	16

Sources: Natural Resources Canada.

[1] Production values for China and Russia exclude most construction materials because those data could not be obtained. Actual production values per capita are higher than indicated here.

TABLE 3. VALUE OF NON-PETROLEUM MINERAL PRODUCTION PER SQUARE KILOMETRE OF THE 25 COUNTRIES WITH THE HIGHEST VALUE OF NON-PETROLEUM MINERAL PRODUCTION IN 1996

Rank	Country	Production Value Per Square Kilometre
		(US$)
1	South Korea	53 434
2	Germany	26 303
3	Japan	24 370
4	Poland	21 419
5	North Korea	20 388
6	United Kingdom	18 520
7	Italy	17 352
8	South Africa	14 747
9	Chile	12 096
10	Spain	8 764
11	China[1]	8 283
12	United States	6 255
13	France	5 712
14	Turkey	5 434
15	Ukraine	5 229
16	India	4 707
17	Peru	3 714
18	Mexico	3 563
19	Indonesia	3 176
20	Australia	2 187
21	Iran	1 917
22	Canada	1 465
23	Kazakhstan	1 287
24	Brazil	1 164
25	Russia[1]	997

Sources: Natural Resources Canada.

[1] Production values for China and Russia exclude most construction materials because those data could not be obtained. Actual production values per square kilometre are higher than indicated here.

Statistical Report

This statistical summary of the Canadian mineral industry has been compiled by staff of the Minerals and Mining Statistics Division, Minerals and Metals Sector, Natural Resources Canada (NRCan), under the general direction of Yvan Gauthier, Director.

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Statistics contained in this summary are obtained from a variety of sources. Principal sources include the statistical survey programs of NRCan and Statistics Canada. The statistical survey program of the Minerals and Mining Statistics Division of NRCan is conducted jointly with the provincial governments and Statistics Canada in order to minimize the reporting burden on the mineral industry. The cooperation of the companies providing information is greatly appreciated.

*(**Note to Reader:** We continue to review the tables of this Report in order to establish the requirements of users. We would appreciate your feedback on which tables are important to you. Please contact Laurie Morrison at tel. (613) 992-6767 or e-mail lmorriso@nrcan.gc.ca to provide your input.)*

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TABLE 1. MINERAL PRODUCTION OF CANADA, 1997-2000p

	Unit	1997		1998		1999		2000p	
	(000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)
METALS									
Antimony	kg	529	1 610	359	845	357	733	364	775
Bismuth	kg	196	1 956	186	2 078	217	2 402	202	2 323
Cadmium	kg	1 272	1 991	1 179	1 104	1 115	647	1 095	576
Calcium	kg	x	x	x	x	x	x	x	x
Cesium, pollucite	kg	x	x	x	x	x	x	x	x
Cobalt	kg	2 168	154 408	2 262	158 643	2 014	112 285	2 013	101 080
Columbium (niobium)	kg	2 253	x	2 194	x	2 313	x	2 170	x
Copper	kg	647 779	2 050 869	690 762	1 695 820	581 583	1 366 138	623 451	1 687 681
Germanium	kg	x	x	x	x	x	x	x	x
Gold	g	171 479	2 527 429	164 773	2 312 593	157 617	2 099 302	153 781	2 045 444
Ilmenite	t	x	x	x	x	x	x	x	x
Indium	g	x	x	x	x	x	x	x	x
Iron ore	t	38 928	1 571 741	36 586	1 646 419	33 990	1 406 296	35 707	1 540 837
Iron, remelt	t	x	x	x	x	x	x	x	x
Lead	kg	170 847	147 612	150 019	117 615	155 369	115 905	143 049	95 843
Lithium	kg	x	x	x	x	x	x	x	x
Magnesium	kg	x	x	x	x	x	x	x	x
Molybdenum	kg	7 594	87 582	8 099	98 752	6 250	59 558	6 833	64 399
Nickel	kg	180 624	1 775 898	197 947	1 411 167	176 749	1 591 805	181 027	2 357 518
Platinum group	g	11 836	134 242	14 033r	214 883r	13 872	250 466	15 439	464 499
Rare earths	t	–	–	–	–	–	–	–	–
Rhenium	kg	–	–	–	–	–	–	–	–
Rubidium	kg	–	–	–	–	x	x	–	–
Selenium	kg	592	5 045	398	2 960	359	2 677	350	4 314
Silver	kg	1 194	260 024	1 140	301 089	1 174	294 516	1 161	277 306
Strontium	kg	x	x	x	x	x	x	x	x
Tantalum	kg	60	7 230	70	9 863	66	9 304	69	9 952
Tellurium	kg	59	831	62	742	64	710	80	515
Tin	kg	–	–	–	–	–	–	–	–
Tungsten	kg	–	–	–	–	–	–	–	–
Uranium	kg	11 127	553 900	9 992	508 038	10 157	525 873	9 919	485 328
Vanadium	kg	–	–	–	–	–	–	–	–
Yttrium	kg	–	–	–	–	–	–	–	–
Zinc	kg	1 026 864	1 870 946	991 584	1 507 208	963 321	1 540 350	935 686	1 567 274
Total metals			11 549 178		10 429 061		9 796 502		11 078 873
NONMETALS									
Asbestos	t	420	214 910	321	167 386	337	161 000	320	143 900
Barite	t	84	7 119	86	9 142	67	6 900	20	4 156
Bentonite	t	–	–	–	–	–	–	–	–
Cement	t	11 736	1 062 708	12 124	1 147 757	12 634	1 232 151	12 612	1 258 697
Clay products		x	136 324	. .	135 814	. .	164 718	. .	175 449
Diamonds	carats	–	–	203	40 755	2 429	606 254	2 558	638 161
Diatomite	t	–	–	–	–	–	–	–	–
Fluorspar	t	–	–	–	–	–	–	–	–
Gemstones	kg	407	1 482	159	631	218	602	200	544
Graphite	t	x	x	x	x	x	x	x	x
Gypsum	t	8 628	95 263	8 307	94 349	9 345	106 634	8 548	95 853
Lime	t	2 477	213 038	2 461	214 966	2 565	238 893	2 547	240 216
Magnesitic dolomite	t	x	x	x	x	x	x	x	x
Marl	t	x	x	x	x	x	x	x	x
Mica	t	x	x	x	x	x	x	x	x
Nepheline syenite	t	648	51 319	636	53 405	676	57 400	703	60 593
Peat	t	1 054	146 404	1 125	166 542	1 180	163 857	1 194	167 830
Perlite	t	–	–	–	–	–	–	–	–
Phosphates	t	–	–	–	–	94	18 427	x	x
Potash	t	9 235	1 528 341	8 884	1 747 985	8 475	1 634 041	9 107	1 714 453
Potassium sulphate	t	x	x	x	x	x	x	x	x
Pumice	t	x	x	x	x	x	x	x	x
Quartz	t	1 690	40 198	1 771	41 849	1 584	41 349	1 520	40 808
Salt	t	13 497	405 509	13 034	390 677	12 686	373 619	11 935	346 512
Sand and gravel	t	225 494	829 190	225 338	875 226	242 369	958 215	246 331	956 209
Serpentine	t	x	x	x	x	x	x	x	x
Soapstone, talc and pyrophyllite	t	72	14 908	72	15 545	79	21 108	86	23 923
Sodium antimonate	t	–	–	–	–	–	–	–	–
Sodium sulphate	t	285	29 040	258	27 080	x	x	x	x
Stone	t	99 265	644 162	108 924	727 947	109 184	775 499	112 348	821 926
Sulphur in smelter gas	t	800	59 462	836	55 451	843	57 851	849	54 520
Sulphur, elemental	t	8 272	84 129	8 404	62 109	8 656	96 969	8 515	98 370
Titanium dioxide	t	x	x	x	x	x	x	x	x
Tremolite	t	x	x	x	x	x	x	x	x
Wollastonite	t	x	x	x	x	x	x	x	x
Zeolite	t	x	x	x	x	x	x		
Total nonmetals		. .	5 912 393	. .	6 527 184	. .	7 315 406	. .	7 448 509
MINERAL FUELS									
Coal	t	78 670	1 920 150	75 360	1 764 770	72 497	1 474 495	69 149	1 315 280
Natural gas	000 m^3	156 171	10 719 153	160 515	10 893 493	162 219	14 192 201	166 078	27 581 160
Natural gas by-products	m^3	26 427	2 599 598	26 666	1 763 072	28 805	2 534 713	29 600	5 298 916
Petroleum	m^3	123 827	17 837 834	128 401	12 940 149	122 247	18 698 282	131 631	31 503 238
Total fuels			33 076 735		27 361 484	. .	36 899 691	. .	65 698 594
Total all minerals			50 538 306		44 317 729		54 011 600		84 225 976

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; x Confidential.
Notes: Numbers may not add to totals due to rounding. Confidential values are included in totals.

TABLE 2. CANADA, VALUE OF MINERAL PRODUCTION, PER CAPITA VALUE OF MINERAL PRODUCTION, AND POPULATION, 1973-2000

	Value of Mineral Production					Per Capita Value of	
Year	Metals	Nonmetals	Structural Materials	Fuels	Total	Mineral Production	Population of Canada
			($ millions)			($)	(000)
1973	3 947	615	678	3 227	8 467	375.31	22 560
1974	4 934	896	835	5 202	11 867	518.78	22 875
1975	5 022	939	959	6 653	13 574	584.86	23 209
1976	5 344	1 166	1 107	8 109	15 726	668.68	23 518
1977	6 031	1 363	1 249	9 873	18 516	778.11	23 796
1978	5 746	1 481	1 508	11 578	20 313	845.11	24 036
1979	8 006	1 870	1 646	15 117	26 638	1 097.25	24 277
1980	9 777	2 531	1 624	17 944	31 875	1 296.10	24 593
1981	8 841	2 714	1 777	19 046	32 378	1 300.32	24 900
1982	6 953	2 105	1 736	23 038	33 831	1 342.39	25 202
1983	7 528	2 021	1 836	27 154	38 539	1 513.95	25 456
1984	8 897	2 538	1 955	30 399	43 789	1 703.72	25 702
1985	8 745	2 736	2 128	31 120	44 730	1 724.23	25 942
1986	8 819	2 523	2 341	18 763	32 446	1 238.21	26 204
1987	10 962	2 381	2 744	20 274	36 361	1 369.53	26 550
1988	13 608	2 757	2 817	17 773	36 955	1 374.05	26 895
1989	13 982	2 706	2 860	19 785	39 333	1 436.61	27 379
1990	12 500	2 529	2 760	22 990	40 778	1 467.31	27 791
1991	10 462	2 407	2 376	19 945	35 190	1 251.42	28 120
1992	10 210	2 239	2 234	20 901	35 584	1 246.72	28 542
1993	8 871	2 147	2 312	23 214	36 545	1 262.48	28 947
1994	9 750	2 648	2 544	26 243	41 185	1 418.41	29 036
1995	12 173	2 906	2 530	25 759	43 367	1 477.38	29 354
1996	11 697	2 766	2 642	32 581	49 687	1 674.54	29 672
1997	11 549	3 027	2 885	33 077	50 538	1 685.33	29 987
1998	10 429	3 425	3 102	27 361	44 318	1 465.20	30 247
1999	9 797	3 946	3 369	36 900	54 012	1 771.40	30 491
2000p	11 079	3 996	3 452	65 699	84 226	2 739.10	30 750

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.
Notes: Beginning in 1986, bentonite, diatomite and sodium antimonate are reported in industrial minerals. Numbers may not add to totals due to rounding.

TABLE 3. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE, TERRITORY AND MINERAL CLASS, 2000p

Province/Territory	Metals		Nonmetals		Mineral Fuels		Total	
	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)
Newfoundland	996 624	9.0	38 928	0.5	2 207 925	3.4	3 243 477	3.9
Prince Edward Island	–	–	5 197	0.1	–	–	5 197	. . .
Nova Scotia	–	–	225 640	3.0	977 063	1.5	1 202 703	1.4
New Brunswick	522 973	4.7	243 428	3.3	24 172	0.0	790 573	0.9
Quebec	2 248 183	20.3	1 368 286	18.4	–	–	3 616 469	4.3
Ontario	3 715 804	33.5	1 986 258	26.7	164 605	0.3	5 866 666	7.0
Manitoba	1 014 484	9.2	75 742	1.0	169 650	0.3	1 259 876	1.5
Saskatchewan	513 682	4.6	1 699 705	22.8	6 279 831	9.6	8 493 217	10.1
Alberta	256	. . .	657 224	8.8	50 183 857	76.4	50 841 338	60.4
British Columbia	1 572 066	14.2	499 213	6.7	5 202 536	7.9	7 273 815	8.6
Yukon	51 942	0.5	3 075	–	48 412	0.1	103 429	0.1
Northwest Territories	58 396	0.5	645 815	8.7	440 542	0.7	1 144 752	1.4
Nunavut	384 464	3.5	–	–	–	–	384 464	0.5
Total	11 078 873	100.0	7 448 509	100.0	65 698 594	100.0	84 225 976	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE AND TERRITORY, 1993-2000

Province/Territory	1993	1994	1995	1996	1997	1998	1999	2000^p
				($ millions)				
Alberta	18 925	21 119	20 676	26 218	26 671	21 886	29 215	50 841
Saskatchewan	3 238	4 225	4 580	5 331	5 508	4 796	5 997	8 493
British Columbia	3 538	4 066	4 501	4 340	4 681	4 466	4 538	7 274
Ontario	4 534	4 921	5 825	5 718	5 615	5 044	5 224	5 867
Quebec	2 692	2 956	3 338	3 415	3 437	3 560	3 657	3 616
Newfoundland	699	837	878	906	1 038	1 539	1 918	3 243
Manitoba	862	820	1 022	1 002	1 126	967	895	1 260
Nova Scotia	554	608	560	593	481	453	380	1 203
Northwest Territories	585	680	766	781	799	585	893	1 145
New Brunswick	772	862	1 021	955	953	863	849	791
Nunavut	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	349	384
Yukon	141	86	196	426	225	150	89	103
Prince Edward Island	4	3	4	4	3	6	7	5
Total	36 545	41 185	43 367	49 687	50 538	44 318	54 012	84 226

Sources: Natural Resources Canada; Statistics Canada.
n.a. Not applicable; ^{p} Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA, PRODUCTION OF LEADING MINERALS, 1999 AND 2000^p

		Volume		Percent Change	Value		Percent Change
		1999	2000^p	2000/1999	1999	2000^p	2000/1999
		(000 tonnes except where noted)			($ millions)		
METALS							
Nickel		176.7	181.0	2.4	1 591.8	2 357.5	48.1
Gold	kg	157 617.1	153 781.2	–2.4	2 099.3	2 045.4	–2.6
Copper		581.6	623.5	7.2	1 366.1	1 687.7	23.5
Zinc		963.3	935.7	–2.9	1 540.3	1 567.3	1.7
Iron ore		33 990.0	35 706.6	5.1	1 406.3	1 540.8	9.6
Uranium	tU	10 157.0	9 918.8	–2.3	525.9	485.3	–7.7
Platinum group	kg	13 872.3	15 438.8	11.3	250.5	464.5	85.5
Silver	t	1 174.3	1 160.9	–1.1	294.5	277.3	–5.8
NONMETALS							
Potash (K_2O equivalent)		8 475.3	9 106.8	7.5	1 634.0	1 714.5	4.9
Cement		12 634.4	12 612.0	–0.2	1 232.2	1 258.7	2.2
Sand and gravel		242 369.0	246 331.2	1.6	958.2	956.1	–0.2
Stone		109 183.7	112 348.4	2.9	775.5	821.9	6.0
Diamonds	000 carats	2 428.8	2 558.0	5.3	606.3	638.2	5.3
Salt		12 685.9	11 935.2	–5.9	373.6	346.5	–7.3
Lime		2 565.5	2 546.5	–0.7	238.9	240.2	0.6
Clay products		. .	. .	. .	164.7	175,4	6.5
Peat		1 179.8	1 193.6	1.2	163.9	167.8	2.4
Asbestos		337.4	320.0	–5.1	161.0	143.9	–10.6
MINERAL FUELS							
Petroleum crude	000 m^3	122 247.4	131 631.3	7.7	18 698.3	31 503.2	68.5
Natural gas	million m^3	162 218.5	166 077.9	2.4	14 192.2	27 581.2	94.3
Natural gas by-products	000 m^3	28 804.8	29 600.0	2.8	2 534.7	5 298.9	109.1
Coal		72 497.0	69 148.5	–4.6	1 474.5	1 315.3	–10.8

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, cat. no. 26-202-XIB.
. . Not available; ^{p} Preliminary.
Note: Numbers have been rounded.

TABLE 6. PRODUCTION OF LEADING MINERALS, BY PROVINCE AND TERRITORY IN CANADA, 2000p

	Unit	Nfld.	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia	Yukon	N.W.T.	Nunavut	Total Canada
	(000)														
Crude oil and equivalent	m^3	8 532	–	363	–	–	240	629	24 179	92 969	3 186	–	1 535	–	131 631
	$	2 207 925	–	98 016	–	–	67 684	169 650	5 073 189	22 669 809	835 475	–	381 490	–	31 503 238
Natural gas	000 m^3	–	–	3 434	–	–	587	–	6 252	133 688	21 128	449	541	–	166 078
	$	–	–	796 094	–	–	96 921	–	1 062 751	22 177 128	3 340 802	48 412	59 052	–	27 581 160
Natural gas by-products	m^3	–	–	80	–	–	–	–	58	27 770	1 692	–	–	–	29 600
	$	–	–	17 115	–	–	–	–	12 068	4 972 859	296 874	–	–	–	5 298 916
Nickel	kg	–	–	–	–	22 898	114 350	43 778	–	–	–	–	–	–	181 027
	$	–	–	–	–	298 205	1 489 186	570 127	–	–	–	–	–	–	2 357 518
Gold	g	1 508	–	–	236	33 658	72 239	7 110	1 866	19	25 197	3 880	4 372	3 696	153 781
	$	20 064	–	–	3 145	447 685	960 848	94 572	24 818	256	335 146	51 602	58 148	49 158	2 045 444
Potash (K_2O equivalent)	t	–	–	–	x	–	–	–	x	–	–	–	–	–	9 107
	$	–	–	–	x	–	–	–	x	–	–	–	–	–	1 714 453
Copper	kg	–	–	–	9 423	92 778	203 711	47 258	625	–	269 656	–	–	–	623 451
	$	–	–	–	25 507	251 150	551 446	127 928	1 692	–	729 959	–	–	–	1 687 681
Zinc	kg	–	–	–	237 535	197 928	85 365	80 929	1 033	–	147 710	–	–	185 185	935 686
	$	–	–	–	397 871	331 529	142 966	135 557	1 731	–	247 415	–	–	310 184	1 567 274
Iron ore	t	21 092	–	–	–	14 516	–	–	–	–	99	–	–	–	35 707
	$	976 432	–	–	–	x	–	–	–	–	x	–	–	–	1 540 837
Coal	t	–	–	1 165	243	–	–	–	10 879	30 986	25 875	–	–	–	69 149
	$	–	–	65 838	24 172	–	–	–	131 823	364 061	729 385	–	–	–	1 315 280
Cement	t	x	–	x	–	2 830	5 344	–	–	x	1 919	–	–	–	12 612
	$	x	–	x	–	240 549	507 182	–	–	x	201 443	–	–	–	1 258 697
Sand and gravel	t	2 837	244	2 408	3 721	25 405	115 478	9 158	10 960	41 525	32 915	1 142	539	–	246 331
	$	7 043	1 144	11 303	11 721	82 774	413 459	26 785	34 096	196 580	163 422	3 075	4 805	–	956 209
Stone	t	4 938	–	7 951	3 436	29 375	55 204	4 351	–	431	6 479	–	184	–	112 348
	$	29 095	–	46 328	19 212	215 234	434 935	18 890	–	4 752	50 631	–	2 848	–	821 926
Diamonds	carats	–	–	–	–	–	–	–	–	–	–	–	2 558	–	2 558
	$	–	–	–	–	–	–	–	–	–	–	–	638 161	–	638 161
Uranium	kg	–	–	–	–	–	–	–	9 919	–	–	–	–	–	9 919
	$	–	–	–	–	–	–	–	485 328	–	–	–	–	–	485 328
Titanium dioxide	t	–	–	–	–	x	–	–	–	–	–	–	–	–	x
	$	–	–	–	–	x	–	–	–	–	–	–	–	–	x
Platinum group	g	–	–	–	–	–	x	x	–	–	–	–	–	–	15 439
	$	–	–	–	–	–	x	x	–	–	–	–	–	–	464 499
Salt	t	–	–	x	x	x	7 174	–	717	1 310	–	–	–	–	11 935
	$	–	–	x	x	x	200 002	–	31 273	21 659	–	–	–	–	346 512
Silver	kg	1	–	–	206	173	148	31	. . .	–	584	1	1	16	1 161
	$	128	–	–	49 184	41 321	35 278	7 336	112	–	139 599	339	248	3 760	277 306
Lime	t	–	–	–	x	x	1 313	x	–	x	x	–	–	–	2 547
	$	–	–	–	x	x	117 105	x	–	x	x	–	–	–	240 216
Iron, remelt	t	–	–	–	–	x	–	–	–	–	–	–	–	–	x
	$	–	–	–	–	x	–	–	–	–	–	–	–	–	x
Clay products	$	x	–	x	–	x	134 036	–	x	x	x	–	–	–	175 449
Peat	t	4	24	x	471	374	–	x	x	156	–	–	–	–	1 194
	$	378	4 053	x	59 621	49 128	–	x	x	23 615	–	–	–	–	167 830
Asbestos	t	–	–	–	–	320	–	–	–	–	–	–	–	–	320
	$	–	–	–	–	143 900	–	–	–	–	–	–	–	–	143 900
Total leading minerals	$	3 242 841	5 197	1 123 370	735 797	3 470 437	5 581 007	1 214 182	8 458 978	50 740 263	7 104 678	103 429	1 144 752	363 103	83 288 034
Total all minerals	$	3 243 477	5 197	1 202 703	790 573	3 616 469	5 866 666	1 259 876	8 493 217	50 841 338	7 273 815	103 429	1 144 752	384 464	84 225 976
Leading minerals as a percentage of all minerals		99.98	100.0	93.40	93.07	95.96	95.13	96.37	99.60	99.80	97.67	100.0	100.0	94.44	98.89

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary; x Confidential.
Notes: Certain minerals are not included in leading minerals due to confidentiality constraints. Confidential values are included in "Total all minerals." Numbers may not add to totals due to rounding.

TABLE 7. CANADA'S WORLD ROLE AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 1999p

		World	Rank of Five Leading Countries 1	2	3	4	5
Potash (K_2O equivalent) (mine production)			**Canada**	C.I.S.	Germany	Israel	United States
	000 t	25 849	**8 304**	7 665	3 545	1 700	1 300
	% of world total		**32.1**	29.7	13.7	6.6	5.0
Uranium (U concentrates) (mine production)			**Canada**	Australia	Niger	Namibia	Uzbekistan
	t	31 651	**8 214a**	5 987	2 916	2 687	2 100
	% of world total		**26.0**	18.9	9.2	8.5	6.6
Nickel (mine production)			Russia	**Canada**	Australia	New Caledonia	Indonesia
	000 t	1 088	235	**186**	126	110	89
	% of world total		21.6	**17.1**	11.6	10.1	8.2
Gypsum (mine production)			United States	**Canada**	China	Iran	Thailand
	000 t	109 686	19 400	**9 886**	9 200	9 000	9 000
	% of world total		17.7	**9.0**	8.4	8.2	8.2
Asbestos (mine production)			C.I.S.	China	**Canada**	Brazil	Zimbabwe
	000 t	1 998	683	400	**340**	200	137
	% of world total		34.2	20.0	**17.0**	10.0	6.9
Titanium concentrate			Australia	South Africa	**Canada**	Norway	India
	000 t	6 220	2 212	1 230	**950e**	590	394
	% of world total		35.6	19.8	**15.3**	9.5	6.3
Zinc (mine production)			China	Australia	**Canada**	Peru	United States
	000 t	8 076	1 476	1 163	**1 021**	900	843
	% of world total		18.3	14.4	**12.6**	11.1	10.4
Cadmium (refined production)			Japan	China	**Canada**	Mexico	Belgium
	t	19 152	2 567	2 000	**1 911**	1 275	1 235
	% of world total		13.4	10.4	**10.0**	6.7	6.4
Platinum group metals (mine production)			South Africa	Russia	**Canada**	United States	Japan
	kg	377 712	224 900	115 700	**13 872**	12 720	6 250
	% of world total		59.5	30.6	**3.7**	3.4	1.7
Aluminum (primary metal)			United States	Russia	China	**Canada**	Australia
	000 t	23 654	3 779	3 146	2 599	**2 390**	1 719
	% of world total		16.0	13.3	11.0	**10.1**	7.3
Salt (mine production)			United States	China	Germany	**Canada**	India
	000 t	199 278	41 400	31 000	15 200	**12 678**	9 500
	% of world total		20.8	15.6	7.6	**6.4**	4.8
Gold (mine production)			South Africa	United States	Australia	China	**Canada**
	t	2 501	449	341	300	170	**158**
	% of world total		18.0	13.6	12.0	6.8	**6.3**
Lead (mine production)			Australia	China	United States	Peru	**Canada**
	000 t	3 018	681	549	520	271	**162**
	% of world total		22.6	18.2	17.2	9.0	**5.4**
Copper (mine production)			Chile	United States	Indonesia	Australia	**Canada**
	000 t	12 684	4 383	1 603	790	718.9	**620**
	% of world total		34.6	12.6	6.2	5.7	**4.9**
Molybdenum (Mo content) (mine production)			United States	China	Chile	Mexico	**Canada**
	t	126 532	43 700	30 000	27 300	7 100	**5 932**
	% of world total		34.5	23.7	21.6	5.6	**4.7**

Sources: Natural Resources Canada, from *World Nonferrous Metal Statistics* and the *Canadian Minerals Yearbook*; U.S. Geological Survey.
C.I.S.: Commonwealth of Independent States; e Estimated; p Preliminary.
a Includes uranium (tU) recovered by Elliot Lake producers from refinery/conversion facility wastes.

TABLE 8. CANADA, GROSS DOMESTIC PRODUCT OF INDUSTRIAL PRODUCTION, MINING AND MINERAL MANUFACTURING AT FACTOR COST AT 1992 PRICES, 1993-2000

	1993	1994	1995	1996	1997	1998	1999	2000
				($ millions)				
Total industrial production[1]	148 010	157 556	164 705	168 979	174 258	178 424	186 369	196 904
Total mining[2]	23 942	25 067	25 932	26 245	27 062	26 590	25 700	27 376
METALS								
Gold mines	1 162	1 061	1 048	1 149	1 161	1 054	1 010	1 004
Iron mines	421	499	501	530	539	527	444	515
Other metal mines	3 077	2 745	2 797	2 820	2 619	2 692	2 447	2 452
MINERAL FUELS								
Crude oil and natural gas	14 708	15 412	15 881	15 733	15 856	16 305	15 832	16 353
NONMETALS								
Asbestos	101	102	x	x	x	x	x	x
Miscellaneous nonmetals	223	264	x	x	x	x	x	x
Potash	655	792	845	747	828	852	772	852
Salt	142	167	142	162	178	173	162	155
Coal	929	966	1 017	1 042	1 106	1 041	997	944
Quarry and sand pits	609	679	757	786	822	938	976	1 026
SERVICES RELATED TO MINING	1 915	2 380	2 567	2 941	3 620	2 677	2 460	3 491
MINERAL MANUFACTURING								
Primary metals	5 617	5 646	5 809	5 907	6 229	6 295	6 403	6 520
Primary steel	2 292	2 347	2 388	2 268	2 340	2 273	2 371	2 359
Steel pipe and tube mills	422	457	425	532	687	679	683	729
Iron foundries	514	498	591	497	544	528	495	478
Nonferrous smelting and refining	1 633	1 600	1 641	1 729	1 735	1 800	1 749	1 798
Casting, rolling and extruding	756	744	764	881	923	1 015	1 105	1 156
Nonmetallic mineral products	2 589	2 656	2 704	2 909	3 185	3 467	3 731	3 749
Hydraulic cement	339	375	370	423	494	510	530	532
Concrete products	358	384	433	411	471	510	563	592
Ready-mix concrete	453	461	423	472	504	540	579	600
Glass and glass products	609	626	634	673	736	898	1 000	1 131
Clay products	105	96	82	94	115	122	115	91
Abrasives	98	89	99	102	93	93	85	84
Lime	86	87	97	105	123	114	110	106
Miscellaneous nonmetallic products	541	538	566	629	649	680	749	613
Petroleum and coal products	982	1 029	1 044	1 064	1 057	1 051	1 081	1 096

Sources: Natural Resources Canada; Statistics Canada.
x Confidential.
[1] Industrial production includes mining (including milling), quarrying and oil wells, mineral manufacturing and other utility industries. [2] Total mining includes metal mining, nonmetal mining (including coal mining), quarries and sand pits, crude petroleum and natural gas, and services incidental to mineral extraction.

TABLE 9. CANADA, GROSS DOMESTIC PRODUCT BY INDUSTRY AT FACTOR COST AT 1992 PRICES, 1993-2000

	1993	1994	1995	1996	1997	1998	1999	2000
				($ millions)				
Gross domestic product, all industries	618 422	645 957	663 082	672 799	700 039	721 879	753 047	786 754
Agriculture	11 127	11 391	11 682	12 319	11 738	12 390	13 401	12 972
Fishing and trapping	1 059	865	704	724	747	733	723	708
Logging and forestry	4 243	4 442	4 645	4 281	4 316	4 221	4 608	4 698
Mines (including milling), quarries and oil wells	23 942	25 067	25 932	26 245	27 062	26 590	25 700	27 376
Manufacturing	101 101	108 859	114 239	115 659	122 320	127 335	135 419	143 107
Construction	35 774	36 880	35 661	36 981	39 398	39 336	40 974	42 286
Transportation and storage	27 109	29 380	30 368	31 214	32 645	33 506	34 924	36 602
Communications	19 096	19 886	20 641	21 133	22 032	23 862	27 122	29 906
Electric power, gas and water utilities	22 967	23 630	24 534	25 075	24 876	24 499	25 250	26 421
Trade, wholesale	31 435	34 194	34 696	36 143	39 670	42 787	47 907	50 331
Trade, retail	36 537	38 793	40 282	41 038	43 719	45 733	47 987	50 790
Finance, insurance and real estate	100 556	105 182	108 183	110 656	115 417	118 589	121 393	126 434
Community, business and personal services	29 227	30 874	33 385	34 610	38 276	41 525	45 112	49 681
Government services	45 401	45 725	45 646	44 736	44 438	44 969	45 983	47 194

Source: Statistics Canada.

TABLE 10. CANADA, STAGE I TO STAGE IV, DOMESTIC EXPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 1998-2000

	Unit of Measure	1998		1999		2000^{P}	
	(000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)
METALS							
Aluminum	. .	. .	7 116 487	. .	7 196 181	. .	7 998 602
Antimony	kg	769	1 403	58	491	62	447
Bismuth	kg	175	2 015	188	2 102	281	3 038
Cadmium	kg	2 097	3 205	2 231	3 789	2 171	4 170
Calcium metal	kg	5 621	3 743	1 973	2 615	1 350	2 530
Chromium	kg	7 074	31 939	6 478	29 914	6 716	30 065
Cobalt	kg	7 049	472 106	6 541	295 282	5 236	234 099
Copper	. .	. .	2 432 249	. .	1 999 092	. .	2 410 494
Gold	. .	. .	3 384 921	. .	2 811 460	. .	2 588 961
Iron and steel	. .	. .	9 600 323	. .	9 813 065	. .	11 046 315
Iron ore	t	30 293	1 289 784	26 477	1 052 194	26 327	1 053 290
Lead	. .	. .	275 946	. .	280 242	. .	277 701
Magnesium and magnesium compounds	kg	111 569	273 404	118 088	251 656	123 261	232 661
Molybdenum	kg	10 778	67 770	10 688	47 480	10 648	48 648
Nickel	. .	. .	1 927 514	. .	1 697 581	. .	2 459 376
Platinum group	. .	. .	207 882	. .	204 003	. .	341 897
Silver	. .	. .	508 457	. .	488 117	. .	466 870
Tin	. .	. .	13 791	. .	11 818	. .	11 816
Titanium metals	kg	30 178	17 134	34 127	39 620	90 035	16 806
Uranium and thorium	. .	. .	786 159	. .	719 140	. .	622 492
Zinc	kg	1 088 406	1 552 139	1 029 258	1 587 855	1 026 386	1 661 503
Other metals	. .	60 386	4 774 704	64 292	4 985 880	68 979	6 436 301
Total metals		. .	34 743 075	. .	33 519 577	. .	37 948 082
NONMETALS							
Asbestos	. .	. .	264 272	. .	271 021	. .	260 821
Barite and witherite	t	25	9 158	16	6 061	11	3 995
Cement	t	. .	627 716	. .	735 696	. .	746 791
Clay products	. .	. .	39 821	. .	45 577	. .	51 388
Diamonds	. .	. .	49 453	. .	559 734	. .	543 347
Graphite	. .	. .	134 099	. .	106 060	. .	84 225
Gypsum	. .	. .	341 551	. .	461 821	. .	286 534
Lime	kg	171 447	21 300	96 058	13 214	80 630	11 436
Mica	t	18	11 289	24	14 214	25	14 651
Nepheline syenite	t	338	52 205	331	48 959	377	52 130
Peat	. .	. .	320 963	. .	331 366	. .	330 099
Potash and potassium compounds	kg	14 278 282	1 978 593	14 361 803	2 109 106	15 141 272	2 428 620
Salt and sodium compounds	t	5 228	543 035	4 862	492 253	4 576	491 833
Sand and gravel	t	1 999	19 723	2 874	25 713	3 184	29 664
Silica and silica compounds	t	. .	16 923	. .	22 179	. .	22 519
Stones	. .	4 181	138 546	3 121	154 268	3 487	185 066
Sulphur and sulphur compounds	t	6 900	359 787	6 050	322 093	5 800	335 659
Talc, soapstone and pyrophyllite	t	30	10 227	44	17 723	59	22 885
Titanium oxides	kg	83 939	211 332	82 287	212 456	70 546	186 991
Other nonmetals	. .	4 835 477	2 917 617	6 754 484	3 103 762	7 893 289	3 239 146
Total nonmetals		. .	8 067 610	. .	9 053 276	. .	9 327 800
FUELS							
Coal and coke	t	33 491	2 522 542	34 270	2 044 336	31 830	1 820 446
Natural gas	000 m^3	89 163	8 967 101	95 121	10 951 393	100 038	20 137 065
Natural gas by-products	000 m^3	9	863 115	8	977 309	9	1 727 530
Petroleum	. .	. .	12 949 875	. .	14 993 529	. .	27 632 121
Other fuels	kg	163 828	269 669	170 986	251 238	208 919	300 188
Total fuels		. .	25 572 302	. .	29 217 805	. .	51 617 350
Total mineral domestic exports (including fuels)		. .	68 382 987	. .	71 790 658	. .	98 893 232
Total economy domestic exports		. .	297 509 000	. .	331 346 516	. .	384 131 878

Sources: Natural Resources Canada; Statistics Canada.
. . Not available or not applicable; P Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 11. CANADA, STAGE I TO STAGE IV, IMPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 1998-2000

	Unit of Measure	1998		1999		2000^{p}	
	(000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)
METALS							
Aluminum	. .	. .	4 372 792	. .	4 448 324	. .	5 007 004
Antimony	kg	2 671	9 749	2 623	8 449	2 653	8 495
Bismuth	kg	220	2 426	182	1 564	424	2 638
Cadmium	kg	35	607	63	837	75	1 217
Calcium metal	kg	74 784	47 578	101 553	48 467	122 687	51 680
Chromium	kg	96 022	94 036	98 974	80 829	69 903	79 250
Cobalt	kg	1 522	62 975	1 190	37 561	1 540	49 372
Copper	. .	. .	1 626 843	. .	1 660 206	. .	3 349 762
Gold	. .	. .	1 577 864	. .	1 059 412	. .	962 845
Iron and steel	. .	. .	15 369 091	. .	15 457 952	. .	17 132 502
Iron ore	t	7 279	389 217	6 950	355 665	6 618	364 182
Lead	. .	. .	473 184	. .	396 467	. .	489 988
Magnesium and magnesium compounds	kg	277 285	186 664	200 048	211 504	239 905	192 643
Molybdenum	kg	4 216	41 009	5 040	39 405	5 030	38 494
Nickel	. .	. .	551 820	. .	307 163	. .	404 154
Platinum group	g	215 525	182 456	1 549 407	181 782	2 106 095	378 171
Silver	. .	. .	136 848	. .	134 242	. .	150 400
Tin	. .	. .	61 543	. .	73 515	. .	71 039
Titanium metal	kg	8 327	94 963	7 876	68 302	11 740	151 783
Uranium and thorium	. .	. .	223 769	. .	295 282	. .	252 804
Zinc	. .	. .	234 849	. .	262 471	. .	269 475
Other metals	. .	. . .	9 835 087	. . .	10 719 016	. . .	11 808 619
Total metals		. .	35 575 370	. .	35 848 415	. .	41 216 517
NONMETALS							
Asbestos	. .	. .	81 054	. .	102 948	. .	103 099
Barite and witherite	t	13	2 480	56	7 164	58	6 735
Cement	. .	. .	210 250	. .	210 881	. .	233 727
Clay products	. .	. .	882 954	. .	893 347	. .	979 513
Diamonds	. .	. .	251 095	. .	295 824	. .	342 762
Graphite	. .	. .	447 385	. .	505 945	. .	471 497
Gypsum	. .	. .	36 126	. .	48 226	. .	48 290
Lime	kg	34 031	5 752	54 535	7 723	62 531	8 102
Mica	t	5	11 465	5	13 265	7	12 749
Nepheline syenite	t	. . .	3	. . .	13	. . .	2
Peat	. .	. .	2 743	. .	1 814	. .	1 219
Potash and potassium compounds	kg	118 381	41 572	106 868	37 365	132 290	44 672
Salt and sodium compounds	t	1 928	308 433	2 406	315 761	2 264	342 710
Sand and gravel	t	3 068	18 956	3 078	18 188	2 953	17 675
Silica and silica compounds	. .	. .	143 379	. .	196 145	. .	217 360
Stone	. .	4 051	133 061	4 307	135 455	4 448	138 621
Sulphur and sulphur compounds	kg	191	21 943	196	21 213	221	24 256
Talc, soapstone and pyrophyllite	kg	47	12 173	58	14 541	62	15 510
Titanium oxides	kg	116 799	269 981	111 960	276 418	98 711	262 067
Other nonmetals	. .	. . .	4 045 408	. . .	4 410 145	. . .	5 001 820
Total nonmetals			6 926 213		7 512 381		8 272 386
FUELS							
Coal and coke	t	20 881	1 141 527	20 933	1 116 487	21 018	1 174 127
Natural gas	000 m^3	734	104 003	630	87 885	1 201	228 765
Natural gas by-products	000 m^3	. . .	56 797	. . .	71 309	1	146 205
Petroleum	. .	. .	9 057 746	. .	9 777 946	. .	17 293 758
Other fuels	. .	. .	442 673	. .	498 258	. .	519 540
Total fuels			10 802 746		11 551 885		19 362 395
Total mineral imports (including fuels)			53 304 329		54 912 681		68 851 298
Total economy imports			303 420 400		326 820 900		363 163 500

Sources: Natural Resources Canada; Statistics Canada.
. . Not available or not applicable; . . . Amount too small to be expressed; ^{p} Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 12. CANADA, STAGE I TO STAGE IV, VALUE OF MINERALS AND MINERAL PRODUCTS, EXPORTS BY COMMODITY, BY DESTINATION, 2000^{p}

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	6 983 443	383 278	328 777	70 592	232 512	7 998 602
Antimony	444	3	–	–	–	447
Bismuth	1 228	1 400	409	–	1	3 038
Cadmium	2 655	893	399	–	223	4 170
Calcium metal	1 087	1 016	223	–	204	2 530
Chromium	29 967	9	63	–	26	30 065
Cobalt	40 959	53 588	58 717	62	80 773	234 099
Copper	1 867 869	77 985	188 154	46	276 440	2 410 494
Gold	2 464 130	1 357	62 323	5 379	55 772	2 588 961
Iron and steel	10 537 177	168 634	20 523	50 091	269 890	11 046 315
Iron ore	354 255	562 402	25 106	–	111 527	1 053 290
Lead	231 880	31 897	438	538	12 948	277 701
Magnesium and magnesium compounds	187 867	27 935	5 535	211	11 113	232 661
Molybdenum	13 379	13 589	16 870	–	4 810	48 648
Nickel	870 115	735 042	73 974	7	780 238	2 459 376
Platinum group	163 385	178 473	–	–	39	341 897
Silver	416 017	5 654	43 556	–	1 643	466 870
Tin	11 219	433	54	–	110	11 816
Titanium metals	14 606	1 274	94	–	832	16 806
Uranium and thorium	409 640	137 592	48 955	1 394	24 911	622 492
Zinc	1 141 674	325 347	46 795	39	147 648	1 661 503
Other metals	5 640 009	353 543	138 766	23 992	279 991	6 436 301
Total metals	31 383 005	3 061 344	1 059 731	152 351	2 291 651	37 948 082
NONMETALS						
Asbestos	81 373	9 119	33 739	11 463	125 127	260 821
Barite and witherite	3 847	–	–	–	148	3 995
Cement	736 425	2 865	811	38	6 652	746 791
Clay products	42 062	4 137	228	1	4 960	51 388
Diamonds	16 669	525 349	–	–	1 329	543 347
Graphite	65 413	5 311	50	343	13 108	84 225
Gypsum	285 100	469	40	–	925	286 534
Lime	11 431	1	–	–	4	11 436
Mica	11 662	598	1 827	–	564	14 651
Nepheline syenite	44 750	1 857	830	267	4 426	52 130
Peat	302 409	2 006	18 593	12	7 079	330 099
Potash and potassium compounds	1 127 680	47 530	105 949	3 275	1 144 186	2 428 620
Salt and sodium compounds	451 890	1 300	11 811	551	26 281	491 833
Sand and gravel	26 156	–	47	–	3 461	29 664
Silica and silica compounds	19 778	55	–	1	2 685	22 519
Stones	165 756	11 845	3 222	293	3 951	185 066
Sulphur and sulphur compounds	63 100	251	–	22 458	249 850	335 659
Talc, soapstone and pyrophyllite	22 726	34	34	–	91	22 885
Titanium oxides	176 945	6 487	–	–	3 559	186 991
Other nonmetals	3 043 941	78 641	12 735	6 356	97 473	3 239 146
Total nonmetals	6 699 113	697 855	189 916	45 058	1 695 859	9 327 800
FUELS						
Coal and coke	258 568	277 797	699 072	16 156	568 853	1 820 446
Natural gas	20 137 051	–	–	–	14	20 137 065
Natural gas by-products	1 727 497	–	–	–	33	1 727 530
Petroleum	27 380 497	52 636	37 209	137	161 642	27 632 121
Other fuels	261 560	13 876	4 844	205	19 703	300 188
Total fuels	49 765 173	344 309	741 125	16 498	750 245	51 617 350
Total domestic mineral exports	87 847 291	4 103 508	1 990 772	213 907	4 737 755	98 893 232

Sources: Natural Resources Canada; Statistics Canada.
– Nil; ^{p} Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 13. CANADA, STAGE I TO STAGE IV, VALUE OF MINERALS AND MINERAL PRODUCTS, IMPORTS BY COMMODITY, BY ORIGIN, 2000^{p}

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	3 703 214	275 689	12 127	9 052	1 006 922	5 007 004
Antimony	6 696	1 068	7	–	724	8 495
Bismuth	2 069	176	–	25	368	2 638
Cadmium	746	408	5	1	57	1 217
Calcium metal	39 973	7 306	94	. . .	4 307	51 680
Chromium	24 757	5 563	1 298	2 022	45 610	79 250
Cobalt	14 007	12 377	4 877	2	18 109	49 372
Copper	2 670 560	167 706	13 174	38 297	460 025	3 349 762
Gold	569 424	26 594	106	7 267	359 454	962 845
Iron and steel	11 748 347	1 682 362	676 096	453 768	2 571 929	17 132 502
Iron ore	352 043	1 904	. . .	4	10 231	364 182
Lead	373 647	19 230	17 539	13 381	66 191	489 988
Magnesium and magnesium compounds	105 159	11 586	925	210	74 763	192 643
Molybdenum	30 088	2 425	18	646	5 317	38 494
Nickel	187 294	76 452	40 406	8 565	91 437	404 154
Platinum group	225 367	57 604	1 443	45	93 712	378 171
Silver	59 184	13 674	1 039	22 093	54 410	150 400
Tin	42 341	1 993	9	286	26 410	71 039
Titanium metals	78 444	14 783	5 715	25	52 816	151 783
Uranium and thorium	56 458	13 193	4	–	183 149	252 804
Zinc	181 327	14 217	208	25 154	48 569	269 475
Other metals	7 583 320	924 931	340 712	1 020 915	1 938 740	11 808 618
Total metals	28 054 465	3 331 241	1 115 802	1 601 758	7 113 250	41 216 516
NONMETALS						
Asbestos	82 756	2 931	3 595	2 404	11 413	103 099
Barite and witherite	3 964	322	–	–	2 449	6 735
Cement	191 343	15 179	714	1 503	24 988	233 727
Clay products	408 060	249 030	27 554	48 638	246 231	979 513
Diamonds	62 749	97 283	46	39	182 645	342 762
Graphite	346 251	56 070	31 868	1 563	35 745	471 497
Gypsum	43 241	758	155	3 319	817	48 290
Lime	8 058	19	–	–	25	8 102
Mica	9 652	1 915	284	22	876	12 749
Nepheline syenite	2	–	–	–	–	2
Peat	286	383	. . .	–	550	1 219
Potash and potassium compounds	38 951	2 631	41	30	3 019	44 672
Salt and sodium compounds	294 795	26 259	2 299	6 550	12 807	342 710
Sand and gravel	17 199	187	. . .	15	274	17 675
Silica and silica compounds	183 867	18 850	6 884	1 939	5 820	217 360
Stone	50 243	46 570	19	2 039	39 750	138 621
Sulphur and sulphur compounds	22 835	1 341	4	–	76	24 256
Talc, soapstone and pyrophyllite	14 223	31	299	2	955	15 510
Titanium oxides	183 164	59 806	1 804	–	17 293	262 067
Other nonmetals	3 856 384	450 433	105 824	121 410	467 770	5 001 820
Total nonmetals	5 818 023	1 029 998	181 390	189 473	1 053 503	8 272 386
FUELS						
Coal and coke	1 033 299	2 739	5 996	205	131 888	1 174 127
Natural gas	228 625	23	3	–	114	228 765
Natural gas by-products	142 010	1 919	50	–	2 226	146 205
Petroleum	2 751 409	4 867 456	28 805	397 246	9 248 842	17 293 758
Other fuels	467 817	44 159	2 298	1 056	4 210	519 540
Total fuels	4 623 160	4 916 296	37 152	398 507	9 387 280	19 362 395
Total mineral imports	38 495 648	9 277 535	1 334 345	2 189 738	17 554 033	68 851 297

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; ^{p} Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 14. CANADA, APPARENT USE[1] OF SOME MINERALS AND RELATION TO PRODUCTION,[2] 1997-99

	1997			1998			1999		
	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production
	(tonnes)		(%)	(tonnes)		(%)	(tonnes)		(%)
Quartz silica	1 812 233	1 792 778	101.1	2 112 700^{r}	1 885 926	112.0^{r}	1 686 479	1 564 186	107.8
Lime[3]	2 299 720^{r}	2 476 571	92.9	2 323 628^{r}	2 461 043	94.4^{r}	2 522 928	2 565 451	98.3
Salt	11 125 685	13 496 856	82.4	9 834 352^{r}	13 034 295	75.4^{r}	10 253 300	12 685 895	80.8
Cement[4]	7 155 518	11 736 272	61.0	6 952 314	12 124 058	57.3	7 954 975	12 634 440	63.0
Iron ore	13 695 396	38 927 855	35.2	13 517 652	36 585 595	36.9	16 133 586	35 706 589	45.2
Gypsum	2 866 712^{r}	8 627 772	33.2	2 850 981	8 306 534	34.3	3 241 560	9 345 342	34.7
Potash (K_2O equivalent)	374 711	9 234 742	4.1	202 130	8 883 616	2.3	–	8 475 270	. .
Asbestos	–	420 278	. .	2 039^{r}	321 330	0.6^{r}	5 165	337 367	1.5

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; K_2O Potassium oxide; ^{r} Revised.
[1] "Apparent use" is production plus imports, less exports. [2] "Production" refers to producers' shipments. [3] "Apparent Use" contains slaked lime in the trade data. [4] "Apparent Use" contains clinker cement in the trade data.

TABLE 15. CANADA, REPORTED USE OF MINERALS AND RELATION TO PRODUCTION, 1997-99

		1997			1998			1999		
	Unit of Measure	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production
				(%)			(%)			(%)
METALS										
Aluminum[1]	t	764 438^{r}	2 327 188	32.8^{r}	889 973^{r}	2 374 118	37.5^{r}	999 242	2 389 834	41.8
Antimony	kg	1 158 210	529 198	218.9	791 255	359 347	220.2	865 383	356 745	242.6
Bismuth	kg	10 846	195 720	5.5	14 641	186 400	7.9	17 066	217 135	7.9
Cadmium	kg	123 192	1 272 172	9.7	117 122	1 179 427	9.9	138 789	1 114 921	12.4
Chromium (chromite)	t	15 380	–	. .	16 964	–	. .	x	–	x
Cobalt	kg	136 382	2 167 554	6.3	145 983	2 262 477	6.5	129 988	2 013 897	6.5
Copper[2]	t	224 777	647 779	34.7	246 212	690 762	35.6	266 504	581 583	45.8
Lead[3]	t	92 997	170 847	54.4	87 466	150 019	58.3	92 557	155 369	59.6
Magnesium	t	34 026	x	x	32 563	x	x	42 643	x	x
Manganese ore	t	9 868	–	. .	7 339	–	. .	5 755	–	. .
Mercury	kg	x	–	x	2 803	–	x	x	–	x
Molybdenum (Mo content)	t	2 545	7 594	33.5	2 573	8 099	31.8	3 180	6 250	50.9
Nickel	t	19 447	180 624	10.8	19 243	197 947	9.7	21 983	176 749	12.4
Selenium	kg	9 175	592 135	1.5	9 782	397 876	2.5	12 447	358 759	3.5
Silver	kg	333 402	1 193 970	27.9	334 857	1 140 238	29.4	349 146	1 174 328	29.7
Tellurium	kg	x	59 322	x	x	62 274	x	x	63 945	x
Tin	t	2 850	–	. .	2 753	–	. .	2 791	–	. .
Tungsten (W content)	kg	283 934	–	. .	212 415	–	. .	187 483	–	. .
Zinc[3]	t	133 553	1 026 864	13.0	138 424	991 584	14.0	143 188	963 321	14.9
NONMETALS										
Barite	t	11 765	84 091	14.0	16 206	86 159	18.8	15 161	87 161	22.6
Feldspar	t	1 578	–	. .	1 588	–	. .	1 090	–	. .
Fluorspar	t	75 791	–	. .	92 822	–	. .	79 157	–	. .
Mica	t	3 334	x	x	3 606	x	x	3 692	x	x
Nepheline syenite	t	73 264	648 280	11.3	69 634	636 406	10.9	57 693	676 169	8.5
Phosphate rock	t	x	–	. .	x	–	. .	x	–	. .
Potash (K_2O equivalent)	t	217 841	9 234 742	2.4	271 078	8 883 616	3.1	223 645	8 475 270	2.6
Sodium sulphate	t	112 906	285 196	39.6	117 131	258 249	45.4	109 647	x	x
Sulphur	t	758 886	9 072 374	8.4	765 093	9 240 245	8.3	746 890	9 498 810	7.9
Talc, etc.	t	84 991	72 444	117.3	82 696	72 095	114.7	75 815	79 493	95.4
MINERAL FUELS										
Coal	000 t	55 734	78 670	70.8	58 846	75 360	78.1	58 092	72 497	80.1
Crude oil[4]	000 m^3	96 431	123 827	77.9	95 435	128 401	74.3	96 938	122 247	79.3
Natural gas[5]	million m^3	52 541	156 171	33.6	45 608	160 515	28.4	45 154	162 219	27.8

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; ^{r} Revised; x Confidential.
[1] Use of primary and recycled aluminum and alloys, and scrap, reported by users. [2] "Use" is defined as domestic shipments of refined copper plus imports of refined copper.
[3] Use of primary and recycled refined metal. [4] "Use" is defined as refinery receipts. [5] "Use" is defined as domestic sales.
Notes: Unless otherwise stated, use refers to reported use of refined metals or nonmetallic minerals by users. Production of metals, in most cases, refers to production in all forms, and includes the recoverable content of ores, concentrates, matte, etc., and the metal content of primary products recoverable at domestic smelters and refineries. Production of nonmetals refers to producers' shipments. For fuels, production is equivalent to actual output less waste.

TABLE 16. CANADA, DOMESTIC USE OF PRINCIPAL REFINED METALS IN RELATION TO REFINERY PRODUCTION,[1] 1993-99

	Unit of Measure	1993	1994	1995	1996	1997	1998	1999
ALUMINUM								
Domestic use[2]	t	568 854	635 024	635 402	676 935[r]	764 438[r]	889 973[r]	999 242
Production	t	2 308 867	2 254 683	2 171 992	2 283 212	2 327 188	2 374 118	2 389 834
Use as a percentage of production	%	24.6	28.2	29.3	29.6[r]	32.8[r]	37.5[r]	41.8
COPPER								
Domestic use[3]	t	185 565	199 350	189 550	218 280	224 777	246 212	266 504
Production	t	561 580	549 869	572 616	559 200	560 582	562 261	548 563
Use as a percentage of production	%	33.0	36.3	33.1	39.0	40.1	43.8	48.6
LEAD								
Domestic use[4]	t	91 915	95 764	91 171	93 373	92 997	87 466	92 557
Production[5]	t	217 014	251 640	281 391	310 791	271 395	265 487	266 415
Use as a percentage of production	%	42.4	38.1	32.4	30.0	34.3	32.9	34.7
ZINC								
Domestic use[4]	t	110 570[r]	122 118	130 735	134 787	133 553	138 424	143 188
Production	t	659 881	690 965	720 346	716 467	703 798	745 131	776 927
Use as a percentage of production	%	16.8[r]	17.7	18.1	18.8	19.0	18.6	18.4

Source: Natural Resources Canada.
[r] Revised.
[1] Production of refined metal from all sources, including metal derived from recycled materials at primary refineries. [2] Use of primary and recycled aluminum and alloys, and scrap, reported by users. [3] Use is defined as domestic shipments of refined copper plus imports of refined copper. [4] Use of primary and recycled refined metal, reported by users. [5] Production of primary and recycled refined lead.

TABLE 17. AVERAGE ANNUAL PRICES[1] OF SELECTED METALS, 1993-2000

	Unit	1993	1994	1995	1996	1997	1998	1999	2000
Aluminum, London Metal Exchange	¢/lb	51.639	66.986	81.903	68.296	72.544	61.574	61.738	70.267
Antimony, New York dealer	$/lb	0.769	1.777	2.278	1.466	0.996	0.718	0.627	0.655
Bismuth, New York dealer	$/lb	2.350	3.070	3.781	3.546	3.275	3.408	3.378	3.539
Cadmium, New York dealer	$/lb	0.451	1.144	1.839	1.238	0.513	0.286	0.177	0.164
Cobalt, metal, shot/cathode/250 kg	$/lb	18.000	19.900	27.069	27.500	27.500	27.500	27.500	27.500
Copper, electrolytic cathode, COMEX	¢/lb	85.283	107.052	134.717	105.872	103.580	75.077	72.111	83.971
Gold, London[2]	$/troy oz	359.769	384.009	384.162	387.696	331.096	294.160	278.825	278.600
Indium, New York dealer	$/troy oz	45.667	30.000	30.000	46.188	171.125	392.032	379.938	390.000
Lead, London Metal Exchange cash	¢/lb	18.417	24.829	28.600[r]	35.019	28.292	23.960	22.778	20.574
Magnesium, U.S. primary ingot (Producer Price List)	$/lb	1.530	1.538	1.805	1.930	1.800	1.800	1.800	1.800
Molybdenum, oxide, dealer	$/lb	2.279	4.501	7.412	3.606	4.175	3.313	2.591	2.498
Nickel, cathode, New York dealer	$/lb	2.428	2.919	3.901	3.501	3.221	2.179	2.750	3.987
Osmium, New York dealer	$/troy oz	400.000	400.000	399.375	392.458	391.000	366.867	350.000	350.000
Palladium, London PM fix	$/troy oz	122.348	142.631	151.229	128.079	177.951	284.678	357.902	681.100
Platinum, London PM fix	$/troy oz	374.027	404.998	424.346	397.171	395.210	372.019	376.880	544.226
Rhodium, New York dealer	$/troy oz	1 066.111	712.678	424.145	280.721	268.458	574.771	863.063	1 818.750
Ruthenium, New York dealer	$/troy oz	12.996	13.604	21.827	34.921	32.896	39.208	34.721	118.275
Selenium, New York dealer	$/lb	4.900	4.900	4.897	3.423	2.791	2.274	2.278	3.699
Silver, Handy & Harman, Toronto	$/troy oz	4.300	5.284	5.192	5.183	4.892	5.534	5.250	5.003
Tantalum, tantalite ore, spot	$/lb	25.850	25.500	26.260	27.000	27.000	32.783	33.000	62.438
Tin, New York dealer	$/lb	2.392	2.549	2.945	2.890	2.644	2.613	2.545	2.549
Tungsten, U.S. spot ore	$/stu	34.800	36.750	56.402	55.000	53.333	44.021[r]	40.000	40.000
Uranium, U_3O_8	$/lb	15.000	14.000	13.000	15.100[r]	14.200	13.300	12.700	12.400
Zinc, special high grade	¢/lb	43.635	45.255	53.235	51.109	59.697	46.453	48.805	51.150

Sources: Natural Resources Canada; *Metals Week*.
COMEX: Commodities Exchange, Inc.
[r] Revised; stu Short ton unit.
[1] Prices, except where noted, are in U.S. currency. [2] Average afternoon fixings of London bullion dealers.

TABLE 18. CANADIAN AVERAGE ANNUAL PRICES OF SELECTED METALS, 1993-2000

	Unit	1993	1994	1995	1996	1997	1998	1999	2000
Aluminum, London Metal Exchange	$/kg	1.469	2.017	2.478	2.054	2.215	1.952	2.021	2.301
Antimony, New York dealer	$/kg	2.187	5.350	6.893	4.408	3.042	2.276	2.053	2.145
Bismuth, New York dealer	$/kg	6.684	9.243	11.441	10.663	10.000	10.805	11.059	11.588
Cadmium, New York dealer	$/kg	1.283	3.444	5.565	3.723	1.566	0.907	0.579	0.537
Cobalt, metal, shot/cathode/250 kg	$/kg	51.195	59.916	81.906	82.695	83.968	87.188	90.029	90.043
Copper, electrolytic cathode, COMEX	$/kg	2.426	3.223	4.076	3.184	3.163	2.380	2.361	2.749
Gold, London[1]	$/g	14.922	16.861	16.952	17.002	14.743	13.601	13.312	13.303
Iridium, New York dealer	$/g	1.894	1.317	1.324	2.026	7.620	18.126	18.139	18.623
Lead, London Metal Exchange, cash	¢/kg	40.602	54.739	63.052	77.204	62.373	52.823	50.217	45.358
Magnesium, U.S. primary ingot (Producer Price List)	$/kg	4.352	4.631	5.462	5.804	5.496	5.707	5.893	5.894
Molybdenum, oxide, dealer	$/kg	6.482	13.552	22.428	10.844	12.748	10.504	8.482	8.179
Nickel, cathode, New York dealer	$/kg	6.906	8.789	11.804	10.528	9.835	6.908	9.003	13.055
Osmium, New York dealer	$/g	16.591	17.563	17.623	17.211	17.411	16.962	16.710	16.713
Palladium, London PM fix	$/g	5.075	6.263	6.673	5.617	7.924	13.162	17.087	32.523
Platinum, London PM fix	$/g	15.514	17.783	18.725	17.417	17.598	17.201	17.993	25.987
Rhodium, New York dealer	$/g	44.220	31.292	18.716	12.311	11.954	26.575	41.205	86.846
Ruthenium, New York dealer	$/g	0.539	0.597	0.963	1.531	1.465	1.813	1.658	5.648
Selenium, New York dealer	$/kg	13.936	14.753	14.818	10.293	8.522	7.210	7.458	12.112
Silver, Handy & Harman, Toronto	$/kg	178.354	232.011	229.107	227.293	217.835	255.870	250.653	238.895
Tantalum, tantalite ore, spot	$/kg	73.522	76.777	79.459	81.192	82.442	103.937	108.034	204.441
Tin, New York dealer	$/kg	6.803	7.675	8.911	8.690	8.075	8.284	8.333	8.346
Tungsten, U.S. spot ore	$/mtu	44.186	49.397	76.189	73.835	72.700	62.307	58.460	58.470
Uranium	$/kg	50.000	51.000	47.000	53.600r	51.300	51.100	49.100	49.700
Zinc, special high grade	$/kg	1.241	1.363	1.611	1.537	1.823	1.473	1.598	1.675

Sources: Natural Resources Canada; *Metals Week*.
COMEX: Commodities Exchange, Inc.
mtu Metric tonne unit; r Revised.
[1] Average afternoon fixings of London bullion dealers.

TABLE 19. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1998

		Mining Activity							Total Activity[2]		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
BY INDUSTRY											
Metals											
Gold	47	6 374	14 178	430 039	143 779	663 804	2 411 155	1 603 573	8 498	569 101	1 589 561
Silver-lead-zinc	7	1 882	4 309	109 632	43 198	565 612	972 488	363 678	2 734	169 170	363 486
Iron	5	3 943	8 787	306 252	179 907	502 312	1 761 234	1 079 015	4 903	383 894	1 071 383
Nickel-copper-zinc	20	9 401	19 957	560 063	198 881	1 926 932	4 188 386	2 062 572	12 624	804 420	2 091 398
Miscellaneous metal mines[3]	8	1 462	2 953	86 144	54 131	165 652	855 369	635 585	1 975	122 506	637 292
Total	87	23 062	50 184	1 492 130	619 896	3 824 312	10 188 632	5 744 424	30 734	2 049 090	5 753 121
Nonmetals											
Peat	73	1 394	3 132	37 883	8 208	34 711	226 605	183 685	1 665	47 233	184 110
Gypsum	9	536	1 181	23 719	7 889	22 788	96 955	66 278	643	29 265	66 107
Potash	11	2 531	5 810	158 044	122 740	216 131	1 839 206	1 500 335	3 396	232 755	1 498 330
Salt	10	1 057	2 466	55 591	16 957	46 658	375 128	311 513	1 498	79 471	312 249
Diamond	1	84	175	5 700	5 330	15 003	74 300	53 967	93	6 274	53 967
Stone	147	2 427	5 375	98 282	46 494	126 953	576 418	402 970	3 109	129 398	408 235
Sand and gravel	311	3 078	7 020	112 553	61 525	99 500	605 339	444 314	4 341	161 075	461 983
Shale, clay and refractory minerals	6	143	302	7 225	2 866	11 811	58 810	44 132	174	9 030	44 111
Miscellaneous nonmetals[4]	20	1 550	3 233	66 547	31 035	54 336	263 753	178 381	2 119	96 361	179 160
Total	588	12 800	28 695	565 545	303 045	627 892	4 116 515	3 185 577	17 038	790 861	3 208 252
Mineral fuels											
Coal	33	6 692	13 867	380 202	133 569	467 866	1 867 491	1 266 056	8 157	469 303	1 292 897
Total mineral industry	708	42 554	92 746	2 437 877	1 056 510	4 920 070	16 172 637	10 196 057	55 929	3 309 255	10 254 270
BY REGION											
Atlantic provinces	83	5 820	12 664	327 809	130 617	718 500	1 960 830	1 111 714	7 170	404 857	1 105 519
Quebec	206	8 350	18 419	475 412	232 910	923 554	2 823 911	1 667 447	11 459	674 703	1 698 025
Ontario	201	10 841	24 170	628 213	212 718	1 324 376	4 096 543	2 559 449	14 681	884 500	2 554 632
Prairie provinces	147	10 253	21 766	550 712	271 028	835 003	4 278 201	3 172 170	13 203	751 608	3 202 479
British Columbia[4]	61	6 654	14 204	407 574	180 841	952 954	2 547 583	1 413 788	8 314	513 078	1 421 218
Yukon and Northwest Territories[5]	10	636	1 524	48 157	28 397	165 684	465 569	271 488	1 102	80 509	272 396
Total Canada	708	42 554	92 746	2 437 877	1 056 510	4 920 070	16 172 637	10 196 057	55 929	3 309 255	10 254 270

Sources: Natural Resources Canada; Statistics Canada.

[1] Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices. [3] Includes molybdenum and uranium.

[4] Includes asbestos.

Notes: This table no longer includes data for the petroleum and natural gas industries. Numbers may not add to totals due to rounding.

TABLE 20. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, 1998

		Mineral Manufacturing Activity							Total Activity[1]		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
By Industry											
Primary metal manufacturing	482	73 918	151 828	3 640 428	2 017 529	15 832 034	29 596 704	12 064 756	92 118	4 804 221	12 487 078
Nonmetallic mineral product manufacturing	1 606	38 698	82 642	1 431 543	567 951	3 553 217	8 930 171	4 844 851	48 221	1 955 167	5 052 346
Fabricated metal products manufacturing	4 543	140 115	302 858	4 470 350	361 095	11 684 636	22 849 924	10 891 801	164 006	5 689 025	11 232 886
Petroleum and coal products manufacturing	192	6 676	14 366	378 065	336 555	13 934 200	16 324 506	1 894 023	12 591	782 757	2 093 153
Total	6 823	259 407	551 694	9 920 386	3 283 131	45 004 087	77 701 305	29 695 431	316 936	13 231 170	30 865 463
By Region											
Atlantic provinces	302	x	x	x	x	x	x	x	x	x	x
Quebec	1 547	56 394	114 107	2 128 800	1 350 717	10 854 366	20 441 455	8 274 354	74 468	3 062 003	8 679 703
Ontario	3 044	142 980	310 399	5 604 534	1 361 900	22 304 831	38 404 401	15 044 990	170 277	7 320 457	15 254 111
Prairie provinces	1 104	x	x	x	x	x	x	x	x	x	x
British Columbia	826	x	x	x	x	x	x	x	x	x	x
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total	6 823	259 407	551 694	9 920 386	3 283 131	45 004 087	77 701 305	29 695 431	316 936	13 231 170	30 865 463

Source: Statistics Canada, catalogue no. 31-203.

– Nil; x Confidential.

[1] Total activity includes sales and head offices.

TABLE 21. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1988-98

		Mining Activity								Total Activity[2]		
		Production and Related Workers			Costs						
Year	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1988	539	58 251	126 216	2 348 492	970 964	4 463 679	17 060 361	11 625 518	76 995	3 197 809	11 694 930
1989	537	59 593	129 946	2 562 805	1 013 010	4 712 423	17 445 454	11 720 021	78 279	3 480 651	11 826 346
1990	521	55 558	121 448	2 510 817	1 061 769	4 619 245	16 158 688	10 477 673	73 156	3 391 151	10 571 448
1991	498	51 642	112 344	2 446 055	1 043 554	4 318 454	14 359 030	8 997 022	68 747	3 363 119	9 094 572
1992	469	46 819	101 065	2 278 504	960 413	4 249 868	13 705 148	8 494 868	62 257	3 136 794	8 566 223
1993	459	44 053	94 733	2 139 903	933 552	3 931 954	12 598 992	7 733 486	58 325	2 928 793	7 793 020
1994	555	44 083	95 756	2 227 755	970 304	3 938 223	13 872 653	8 964 126	58 195	3 019 806	9 059 983
1995	730	46 728	101 852	2 421 274	1 065 118	4 652 556	16 771 037	11 053 363	61 193	3 262 475	11 133 393
1996r	727	45 552	99 532	2 466 512	1 129 784	4 939 053	16 568 618	10 499 781	59 555	3 306 371	10 575 169
1997r	717	45 011	98 314	2 550 807	1 116 321	5 118 922	16 907 365	10 672 121	58 326	3 397 931	10 744 485
1998	708	42 554	92 746	2 437 877	1 056 510	4 920 070	16 172 637	10 196 057	55 929	3 309 255	10 254 270

Sources: Natural Resources Canada; Statistics Canada.
r Revised.
[1] Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices.
Note: This table no longer includes data for the petroleum and natural gas industries.

TABLE 22. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES,[1] 1982-98

		Mineral Manufacturing Activity							Total Activity[2]		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1982	5 687	229 518	475 378	5 333 201	1 728 740	34 241 605	50 045 037	14 497 245	321 785	8 126 238	14 823 990
1983	7 370	216 944	447 947	5 420 307	1 905 777	34 720 416	52 773 875	15 861 491	301 112	8 143 674	16 196 749
1984	7 511	223 816	470 367	5 948 626	2 125 032	37 738 117	57 207 764	17 980 271	304 309	8 719 151	18 265 131
1985	7 625	238 544	506 377	6 507 081	2 229 270	39 497 925	61 241 939	19 305 730	313 850	9 271 447	19 646 938
1986	7 841	248 039	524 184	6 829 899	2 096 145	31 806 478	54 521 641	19 788 464	319 950	9 563 918	20 124 687
1987	7 598	. .	. .	. .	2 154 276	35 570 988	59 787 220	22 189 903	333 536	10 188 110	22 733 514
1988	8 309	277 965	586 697	8 187 249	2 268 149	35 436 715	62 739 083	25 125 477	350 917	11 191 039	25 725 203
1989	8 300	288 494	606 841	8 893 139	2 341 578	38 785 9[illegible]	64 981 175	24 317 984	360 004	12 014 330	29 859 105
1990	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830
1991	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450
1992	7 482	214 862	489 072	7 656 558	2 530 479	34 191 776	56 436 631	19 375 600	280 226	10 708 582	19 829 810
1993	7 202	211 316	381 263	7 656 373	2 641 864	35 060 212	58 685 636	21 008 722	273 767	10 688 689	21 445 279
1994	7 099	217 412	397 045	7 950 383	2 754 778	33 575 016	65 490 301	24 565 574	279 834	11 040 491	24 993 941
1995	7 151	230 185	492 240	8 537 700	2 862 100	41 112 900	71 292 500	27 936 100	293 594	11 841 500	28 766 000
1996	8 300	230 308	492 074	8 800 500	2 899 400	45 735 300	76 736 600	28 010 400	292 357	12 077 700	28 424 000
1997	8 057	256 877	540 163	9 830 200	3 110 100	48 440 400	81 124 600	29 829 800	321 152	13 447 700	30 254 500
1998	6 823	259 407	551 694	9 920 386	3 283 131	45 004 087	77 701 305	29 695 431	316 936	13 231 170	30 865 463

Source: Statistics Canada.
. . Not available.
[1] Includes the following industries: primary metals, nonmetallic mineral products, fabricated metal products, and petroleum and coal products. [2] Total activity includes sales and head offices.

TABLE 23. CANADA, CONSUMPTION OF FUEL AND ELECTRICITY IN THE NON-FUEL MINERAL INDUSTRY,[1] 1998

	Unit	Metals	Nonmetals[2]	Total
Coal	000 t			
	$000	3	–	3
Gasoline	000 litres	18 099	20 218	38 317
	$000	8 583	9 595	18 178
Fuel oil, kerosene, diesel oil	000 litres	714 522	267 016	981 538
	$000	159 612	92 381	251 993
Liquefied petroleum gas	000 litres	111 410	12 203	123 613
	$000	23 761	2 737	26 498
Natural gas	000 m^3	102 286	791 738	894 024
	$000	13 791	67 629	81 420
Other fuels[3]	$000	39 051	500	39 551
Total value of fuels	$000	244 801	172 842	417 643
Electricity purchased	million kWh	10 754	2 760	13 514
	$000	375 095	130 203	505 298
Total value of fuels and electricity purchased, all reporting companies	$000	619 896	303 045	922 941

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
[1] Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. [2] Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory minerals. [3] Includes wood, manufactured gas, steam purchased, and other miscellaneous fuels.
Note: Numbers may not add to totals due to rounding.

TABLE 24. CANADA, COST OF FUEL AND ELECTRICITY USED IN THE NON-FUEL MINERAL INDUSTRY,[1] 1994-98

	Unit	1994	1995	1996	1997	1998
METALS						
Fuel	$000	207 602	237 376	289 723	283 375	244 801
Electricity purchased	million kWh	10 705	11 527	11 248	11 186	10 754
	$000	368 124	408 270	396 358	383 009	375 095
Total cost of fuel and electricity	$000	575 726	645 646	686 082	666 384	619 896
NONMETALS[2]						
Fuel	$000	96 445	91 148	87 173	95 245	172 842
Electricity purchased	million kWh	2 301	2 363	2 333	2 369	2 760
	$000	108 050	109 676	107 876	96 917	130 203
Total cost of fuel and electricity	$000	204 496	200 824	195 049	192 162	303 045
TOTAL NON-FUEL MINERAL INDUSTRY						
Fuel	$000	346 877	387 133	441 668	444 390	417 643
Electricity purchased	million kWh	13 367	14 270	14 016	13 981	13 514
	$000	500 252	543 219	533 507	509 277	505 298
Total cost of fuel and electricity	$000	847 129	930 353	975 176	953 667	922 941

Sources: Natural Resources Canada; Statistics Canada.
[1] Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. [2] Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory materials.
Notes: Numbers may not add to totals due to rounding. This table does not include data for the coal industry. Further information and data from the Annual Census of Mines is available from publications on the Internet at www.nrcan.gc.ca/mms/efab/mmsd.

TABLE 25. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE I – MINERAL EXTRACTION AND CONCENTRATING (TOTAL ACTIVITY),[1] 1961-2000

Year	Metal Mines	Nonmetal Mines	Structural Materials	Non-Fuel Minerals	Coal	Crude Oil and Natural Gas	Total Non-Fuel and Fuel Mineral Industries
SIC no.	061	062	081, 082	061, 062 081, 082	063	071	
				(number)			
1961	58 591	11 003	5 235	74 829	10 302	11 184	96 315
1962	58 243	11 408	5 514	75 165	9 897	11 232	96 294
1963	57 119	11 661	5 686	74 466	9 828	11 237	95 531
1964	57 648	11 727	6 044	75 419	9 796	11 242	96 457
1965	60 942	12 116	6 248	79 306	9 697	11 817	100 820
1966	61 670	12 422	6 312	80 404	9 281	12 378	102 063
1967	61 728	13 077	5 779	80 584	8 981	13 113	102 678
1968	63 369	13 673	5 836	82 878	8 427	13 611	104 916
1969	60 550	14 322	5 692	80 564	7 371	14 153	102 088
1970	66 590	15 150	5 510	87 250	7 874	14 970	110 094
1971	66 012	15 105	5 328	86 445	8 069	15 896	110 410
1972	61 994	14 866	5 154	82 014	8 704	16 604	107 322
1973	66 134	15 391	5 276	86 801	7 856	16 786	111 443
1974	70 038	16 198	6 197	92 433	8 142	18 155	118 730
1975	69 161	13 703	6 382	89 246	8 416	18 053	115 715
1976	68 269	15 649	5 685	89 603	8 995	19 096	117 694
1977	67 242	16 608	5 190	89 040	9 781	20 240	119 061
1978	56 447	16 035	4 847	77 329	10 574	22 045	109 948
1979	58 960	16 770	4 692	80 422	10 269	24 554	115 245
1980	66 118	16 979	4 461	87 558	11 416	27 448	126 422
1981	68 712	16 391	4 183	89 286	11 182	28 783	129 251
1982	61 503	13 680	3 491	78 674	13 113	31 699	123 486
1983	52 194	13 170	3 403	68 767	11 646	33 418	113 831
1984	52 683	13 698	3 560	69 941	11 905	33 944	115 790
1985	48 672	12 974	3 941	65 587	12 076	38 720	116 383
1986	46 487	12 376	4 887	63 750	10 747	34 936	109 433
1987	45 496	12 181	5 738	63 415	10 406	33 855	107 676
1988	48 277	11 679	5 917	65 873	11 122	33 762	110 757
1989	49 405	11 714	5 881	67 000	11 279	32 696	110 975
1990	45 248	11 515	5 376	62 139	11 017	31 926	105 082
1991	42 092	10 812	5 026	57 930	10 817	31 450	100 197
1992	37 774	10 419	4 338	52 531	9 726	27 678	89 935
1993	34 746	10 500	4 219	49 465	8 860	26 598	84 923
1994	33 380	10 476[r]	5 451[r]	49 307	8 888[r]	27 693	85 888[r]
1995	35 181[r]	10 133[r]	6 815[r]	52 129[r]	9 063[r]	26 491	87 683[r]
1996	34 157[r]	9 457[r]	6 654[r]	50 268[r]	9 177	34 939	94 384[r]
1997	32 912[r]	9 606[r]	6 770[r]	49 288[r]	8 938[r]	36 289	94 515[r]
1998	30 734[r]	9 414[r]	7 626[r]	47 774[r]	8 157[r]	37 863	93 794[r]
1999[p]	28 648[r]	9 463[r]	8 091[r]	46 202[r]	7 117[r]	38 203[r]	91 522[r]
2000[f]	29 248	9 534	8 614	47 396	6 559	38 137	92 092

Sources: Natural Resources Canada; Statistics Canada.
SIC: Standard Industrial Classification, 1980.
[f] Forecast; [p] Preliminary; [r] Revised.
[1] Total activity includes sales and head offices.

TABLE 26. CANADA, EMPLOYMENT, SALARIES AND WAGES IN THE MINERAL INDUSTRY,[1] 1991-98

	Unit	1991	1992	1993	1994	1995	1996	1997	1998
METALS									
Production and related workers	Number	31 168	27 908	25 762	24 809	26 344	25 830	25 121	23 062
Salaries and wages	$000	1 627 254	1 532 118	1 374 090	1 376 286	1 500 141	1 533 204	1 578 374	1 492 130
Average annual salary and wage	$	52 209	54 899	53 338	55 475	56 944	59 357	62 831	64 701
Administrative and office workers	Number	10 924	9 866	8 984	8 571	8 838	8 427	7 891	7 672
Salaries and wages	$000	626 302	587 210	532 735	526 076	558 984	554 226	548 854	556 960
Average annual salary and wage	$	57 333	59 519	59 298	61 379	63 248	65 768	69 554	72 596
Total metals									
Employees	Number	42 092	37 774	34 746	33 380	35 182	34 257	33 012	30 734
Salaries and wages	$000	2 253 556	2 119 328	1 906 825	1 902 362	2 059 125	2 087 429	2 127 228	2 049 090
Average annual salary and wage	$	53 539	56 105	54 879	56 991	58 528	60 934	64 438	66 672
NONMETALS[2]									
Production and related workers	Number	11 699	11 107	11 087	12 002	12 961	12 188	12 541	12 800
Salaries and wages	$000	427 512	427 276	431 540	479 682	536 503	515 292	546 282	565 545
Average annual salary and wage	$	36 543	38 469	38 923	39 967	41 394	42 279	43 560	44 183
Administrative and office workers	Number	4 139	3 650	3 632	3 925	3 987	3 933	3 835	4 238
Salaries and wages	$000	186 910	172 476	171 076	178 263	188 815	191 826	204 804	225 316
Average annual salary and wage	$	45 158	47 254	47 102	45 417	47 358	48 779	53 404	53 166
Total nonmetals									
Employees	Number	15 838	14 757	14 719	15 927	16 948	16 121	16 376	17 038
Salaries and wages	$000	614 421	599 752	602 616	657 945	725 318	707 118	751 085	790 861
Average annual salary and wage	$	38 794	40 642	40 941	41 310	42 797	43 862	45 865	46 417
FUELS (COAL)									
Production and related workers	Number	8 775	7 804	7 204	7 272	7 423	7 534	7 349	6 692
Salaries and wages	$000	391 289	319 110	334 274	371 786	384 630	418 016	426 152	380 202
Average annual salary and wage	$	44 591	40 891	46 401	51 126	51 816	55 484	57 988	56 814
Administrative and office workers	Number	2 042	1 922	1 656	1 616	1 640	1 643	1 589	1 465
Salaries and wages	$000	103 853	98 604	85 078	87 713	93 402	93 808	93 466	89 101
Average annual salary and wage	$	50 858	51 303	51 376	54 278	56 952	57 096	58 821	60 820
Total mineral fuels									
Employees	Number	10 817	9 726	8 860	8 888	9 063	9 177	8 938	8 157
Salaries and wages	$000	495 142	417 714	419 352	459 499	478 032	511 824	519 618	469 303
Average annual salary and wage	$	45 774	42 948	47 331	51 699	52 745	55 772	58 136	57 534
TOTAL MINERAL INDUSTRY									
Production and related workers	Number	51 642	46 819	44 053	44 083	46 728	45 552	45 011	42 554
Salaries and wages	$000	2 446 055	2 278 504	2 139 903	2 227 755	2 421 274	2 466 512	2 550 807	2 437 877
Average annual salary and wage	$	47 366	48 666	48 576	50 535	51 816	54 147	56 671	57 289
Administrative and office workers	Number	17 105	15 438	14 272	14 112	14 465	14 003	13 315	13 375
Salaries and wages	$000	917 064	858 290	788 890	792 052	841 201	839 860	847 124	871 377
Average annual salary and wage	$	53 614	55 596	55 275	56 126	58 154	59 977	63 622	65 150
Total mineral industry									
Employees	Number	68 747	62 257	58 325	58 195	61 193	59 555	58 326	55 929
Salaries and wages	$000	3 363 119	3 136 794	2 928 793	3 019 806	3 262 475	3 306 371	3 397 931	3 309 255
Average annual salary and wage	$	48 920	50 385	50 215	51 890	53 315	55 517	58 258	59 169

Sources: Natural Resources Canada; Statistics Canada.

[1] Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. [2] Includes structural materials.

Notes: This table no longer includes data for the petroleum and natural gas industries. Numbers may not add to totals due to rounding.

TABLE 27. CANADA, NUMBER OF WAGE EARNERS EMPLOYED IN THE NON-FUEL MINERAL INDUSTRY (SURFACE, UNDERGROUND AND MILL), 1991-98

	1991	1992	1993	1994	1995	1996	1997	1998
					(number)			
METALS								
Surface	7 545	6 550	5 973	4 526	4 467	6 358	4 762	5 192
Underground	13 614	12 205	11 281	11 396	12 305	10 610	11 556	9 269
Mill	10 009	9 153	8 508	8 888	9 572	8 862	8 803	8 601
Total	31 168	27 908	25 762	24 810	26 344	25 830	25 121	23 062
NONMETALS[1]								
Surface	4 900	4 553	4 620	5 318	6 369	6 051	6 185	6 286
Underground	2 214	2 125	2 098	2 093	1 967	1 926	1 964	2 009
Mill	4 585	4 429	4 369	4 591	4 625	4 211	4 392	4 506
Total	11 699	11 107	11 087	12 002	12 961	12 188	12 541	12 800
TOTAL NON-FUEL MINERAL INDUSTRY								
Surface	12 445	11 103	10 593	9 844	10 836	12 409	10 947	11 478
Underground	15 828	14 330	13 379	13 489	14 272	12 536	13 520	11 278
Mill	14 594	13 582	12 877	13 479	14 197	13 073	13 195	13 107
Total	42 867	39 015	36 849	36 812	39 305	38 018	37 662	35 862

Source: Natural Resources Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 28. CANADA, MINE AND MILL WORKERS, BY SEX, EMPLOYED IN THE NON-FUEL MINERAL INDUSTRY, 1998

	Mine Workers				Mill Workers		Total	
	Underground		Surface					
	Male	Female	Male	Female	Male	Female	Male	Female
					(number)			
METALS								
Gold	3 717	29	802	34	1 736	56	6 255	119
Silver-lead-zinc	890	4	133	8	824	23	1 847	35
Iron ore	13	–	911	29	2 860	130	3 784	159
Nickel-copper-zinc[1]	4 370	30	2 604	35	2 266	96	9 240	161
Miscellaneous metal mines[2]	199	17	623	13	574	36	1 396	66
Total	9 189	80	5 073	119	8 260	341	22 522	540
NONMETALS								
Peat	–	–	442	32	859	61	1 301	93
Gypsum	123	–	300	–	111	2	534	2
Potash	1 168	19	19	1	1 232	42	2 469	62
Salt	503	1	189	5	350	9	1 042	15
Diamond	–	–	48	4	27	5	75	9
Stone	–	–	1 804	15	590	18	2 394	33
Sand and gravel	–	–	2 770	89	215	4	2 985	93
Shale, clay and refractory minerals	–	–	31	–	111	1	142	1
Miscellaneous nonmetals[3]	195	–	533	4	808	11	1 535	15
Total	1 989	20	6 136	150	4 353	153	12 477	323
Total non-fuel mineral industry[4]	11 178	100	11 209	269	12 613	494	34 999	863

Source: Natural Resources Canada.
– Nil.
[1] Includes copper-zinc and nickel-copper mines. [2] Includes molybdenum and uranium mines. [3] Includes asbestos. [4] Coal data are not available.

TABLE 29. CANADA, LABOUR COSTS FOR METAL MINES IN RELATION TO TONNES MINED, 1996-98

	Number of Wage Earners	Total Wages	Average Annual Wage	Tonnage of Ore Mined	Average Annual Tonnes Mined Per Wage Earner	Wage Cost Per Tonne Mined
	(no.)	($000)	($)	(000 tonnes)	(tonnes)	($)
1996						
Uranium	527	28 245	53 595	1 333	2 530	21.18
Gold	5 350	330 486	61 773	30 901	5 775	10.70
Silver-lead-zinc	1 553	83 214	53 583	11 656	7 505	7.14
Nickel-copper-zinc	8 182	463 280	56 622	98 671	12 059	4.70
Miscellaneous metals	382	20 020	52 407	14 659	38 374	1.37
Iron ore	974	76 455	78 496	95 783	98 339	0.80
Total	16 968	1 001 699	59 035	253 003	14 910	3.96
1997						
Gold	5 142	353 561	68 759	33 924	6 597	10.42
Nickel-copper-zinc	7 738	465 700	60 183	94 892	12 263	4.91
Silver-lead-zinc	1 531	71 962	47 003	9 608	6 275	7.49
Uranium	355	23 408	65 937	979	2 757	23.91
Iron ore	1 010	80 658	79 859	94 430	93 495	0.85
Miscellaneous metals	542	28 061	51 772	14 166	26 136	1.98
Total	16 318	1 023 349	62 713	247 999	15 197	4.13
1998						
Gold	4 314	301 093	69 794	29 736	6 893	10.13
Nickel-copper-zinc	7 307	452 614	61 942	109 413	14 974	4.14
Silver-lead-zinc	1 035	61 142	59 074	8 484	8 196	7.21
Uranium	330	20 179	61 147	377	1 141	53.57
Iron ore	953	78 769	82 653	96 743	101 513	0.81
Miscellaneous metals	522	28 892	55 348	15 142	29 006	1.91
Total	14 461	942 688	65 188	259 893	17 972	3.63

Source: Natural Resources Canada.
Note: Numbers may not add due to rounding.

TABLE 30. CANADA, PERSON-HOURS PAID FOR PRODUCTION AND RELATED WORKERS, AND TONNES OF ORE MINED AND ROCK QUARRIED IN METAL MINES AND OTHER MINERAL OPERATIONS, 1993-98

	Unit	1993[r]	1994[r]	1995[r]	1996[r]	1997[r]	1998
METAL MINES[1]							
Ore mined	Mt	236.5	233.7	260.5	253.0	248.0	259.9
Person-hours paid[2]	million	55.5	53.7	57.1	56.1	54.6	50.2
Person-hours paid per tonne mined	number	0.23	0.23	0.22	0.22	0.22	0.19
Tonnes mined per person-hour paid	t	4.26	4.35	4.56	4.51	4.54	5.18
OTHER MINERAL OPERATIONS[3]							
Ore mined and rock quarried	Mt	151.7	170.5	173.0	167.9	178.4	167.5
Person-hours paid[2]	million	29.4	29.8	29.3	32.1	29.0	26.7
Person-hours paid per tonne mined	number	0.19	0.17	0.17	0.19	0.16	0.16
Tonnes mined per person-hour paid	t	5.16	5.73	5.90	5.23	6.16	6.27

Sources: Natural Resources Canada; Statistics Canada, catalogue nos. 26-201, 26-223 and 26-206.

[r] Revised.

[1] Excludes placer mining. [2] Person-hours paid for production and related workers only. [3] Includes asbestos, potash, gypsum, salt, miscellaneous nonmetals and coal.

TABLE 31. CANADA, AVERAGE WEEKLY WAGES (INCLUDING OVERTIME) FOR HOURLY RATED EMPLOYEES IN THE MINING, MINERAL MANUFACTURING, AND LOGGING AND FORESTRY INDUSTRIES, 1992-2000

	1992	1993	1994	1995	1996	1997	1998	1999	2000
					($)				
Oil and gas extraction	1 096.94	1 146.70	1 171.54	1 208.05	1 242.71	1 252.70	1 298.43	1 333.92	1 352.43
Mining	898.55	903.89	921.83	963.25	1 001.83	998.87	1 053.39	1 039.90	1 094.11
Coal mining	963.66	973.49	989.79	1 028.06	1 057.58	1 045.80	1 138.11	1 126.95	1 204.74
Metal ore mining	959.54	975.93	1 002.30	1 049.60	1 078.85	1 053.23	1 127.77	1 123.25	1 168.98
Nonmetallic ore mining	746.10	738.78	755.07	784.51	825.18	873.86	893.33	882.64	944.20
Support activities for mining and oil and gas extraction	740.83	817.90	816.27	817.21	895.53	948.30	978.06	970.21	1 013.57
Manufacturing	670.03	688.88	705.67	712.75	733.82	752.42	769.90	780.19	794.52
Forestry, logging and support	670.99	680.11	700.01	697.64	745.69	786.46	760.59	765.63	803.21

Source: Statistics Canada; *Annual Estimates of Employment, Earnings and Hours.*

TABLE 32. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY INDUSTRY, 1998-2000

	1998			1999			2000p		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
Agriculture	–	–	–	1	11	60	1	227	24 800
Logging and forestry	4	4 897	476 680	7	2 002	118 290	5	12 320	96 780
Fishing and trapping	–	–	–	–	–	–	–	–	–
Mining	7	771	92 060	8	2 676	150 580	9	4 455	164 440
Manufacturing	113	22 997	597 268	129	25 887	514 252	135	24 281	436 070
Construction	15	11 242	325 840	8	1 014	6 420	7	865	15 540
Transportation and utilities	29	5 771	108 180	43	36 215	685 540	40	7 443	105 190
Trade	41	1 767	43 140	43	2 421	78 755	34	9 638	91 350
Finance, insurance and real estate	14	1 364	38 798	13	499	39 650	15	1 126	30 880
Service	134	182 697	670 400	125	81 859	641 984	107	49 100	473 560
Public administration	21	3 884	82 150	36	6 028	210 190	23	35 889	220 520
Other industries	3	9 012	9 360	–	–	–	–	–	–
Total, all industries	381	244 402	2 443 876	413	158 612	2 445 721	376	145 344	1 659 130

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; p Preliminary.

TABLE 33. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY MINING AND MINERAL MANUFACTURING INDUSTRY, 1998-2000

	1998			1999			2000p		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
MINING	7	771	92 060	8	2 676	150 580	9	4 455	164 440
Metals	3	488	76 440	4	2 174	137 280	3	1 710	140 200
Mineral fuels	1	100	100	1	250	250	3	2 459	20 060
Nonmetals	2	156	8 630	2	225	8 330	2	245	3 710
Quarries	1	27	6 890	1	27	4 720	1	41	470
MINERAL MANUFACTURING	14	1 400	21 130	15	2 515	27 470	23	2 512	73 110
Primary metals	6	1 081	4 160	6	1 926	17 370	5	1 138	35 330
Nonmetallic mineral products	8	319	16 970	9	589	10 100	17	874	34 780
Petroleum and coal products	–	–	–	–	–	–	1	500	3 000

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; p Preliminary.

TABLE 34. CANADA, MINING WAGES AND SALARIES BY PROVINCE, TERRITORY AND MINERAL CLASS, 1997 AND 1998

Province/Territory	1997 Metals	1997 Nonmetals	1997 Coal	1997 Total	1998 Metals	1998 Nonmetals	1998 Coal	1998 Total
	($000)							
Newfoundland	175 643	2 739	–	178 382	178 355	3 479	–	181 834
Prince Edward Island	–	1 194	–	1 194	–	1 104	–	1 104
Nova Scotia	–	39 124	68 749	107 873	–	39 679	54 043	93 722
New Brunswick	74 646	53 787	3 300	131 733	78 070	46 642	3 484	128 197
Quebec	498 398	176 922	–	675 321	511 915	162 788	–	674 703
Ontario	704 014	171 979	–	875 993	697 669	186 831	–	884 500
Manitoba	204 266	11 954	–	216 221	197 115	11 844	–	208 959
Saskatchewan	x	209 931	x	313 675	x	226 705	x	317 680
Alberta	–	x	x	209 269	–	x	x	224 969
British Columbia	233 252	38 548	255 694	527 494	245 434	37 752	229 892	513 078
Yukon	x	x	–	24 852	x	x	–	10 875
Northwest Territories	134 345	–	–	134 345	63 462	6 173	–	69 634
Total	2 127 228	751 085	518 038	3 396 351	2 049 090	790 861	469 303	3 309 255

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: This table no longer includes data for the petroleum and natural gas industries.

TABLE 35. CANADA, SOURCE OF ORES HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1996-98

Mines	1996 Underground	1996 Open-Pit	1996 Total	1997 Underground	1997 Open-Pit	1997 Total	1998 Underground	1998 Open-Pit	1998 Total
	(000 tonnes)								
METALS									
Gold	18 684	12 217	30 901	18 060	15 864	33 924	15 861	13 875	29 736
Silver-lead-zinc	7 617	4 039	11 656	7 835	1 773	9 608	8 310	174	8 484
Uranium	922	411	1 333	535	444	979	377	–	377
Iron	731	95 052	95 783	663	93 767	94 430	372	96 371	96 743
Nickel-copper-zinc	28 851	69 820	98 671	26 504	68 388	94 892	26 201	83 212	109 413
Miscellaneous metals	1 073	13 586	14 659	1 059	13 107	14 166	1 025	14 117	15 142
Subtotal metals	57 879	195 124	253 003	54 656	193 343	247 999	52 145	207 749	259 893
NONMETALS									
Asbestos	x	x	x	x	x	x	x	x	x
Gypsum	933	7 651	8 584	1 114	8 027	9 141	977	7 885	8 863
Potash	34 103	–	34 103	38 932	–	38 932	39 514	–	39 514
Rock salt	11 226	–	11 226	12 690	–	12 690	13 277	–	13 277
Diamonds	–	–	–	–	–	–	–	402	402
Miscellaneous nonmetals	x	x	x	x	x	x	x	x	x
Subtotal nonmetals	48 025	19 466	67 491	54 671	21 982	76 653	55 645	16 495	72 140
MINERAL FUELS									
Coal	4 593	95 766	100 359	4 730	97 005	101 735	3 910	91 453	95 363
Total metals, nonmetals and mineral fuels	110 497	310 357	420 853	114 057	312 330	426 386	111 700	315 696	427 396
Percentage	26.3	73.7	100.0	26.7	73.3	100.0	26.1	73.9	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 36. CANADA, SOURCE OF MATERIAL HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1998

	Underground		Open-Pit			
	Ore	Waste	Ore	Waste	Over-burden	Tailings
			(000 tonnes)			
METALS						
Gold	16 579	3 598	19 875	40 597	2 686	34 605
Silver-lead-zinc	8 310	564	174	841	–	7 295
Uranium	377	158	–	–	–	912
Iron	372	–	96 371	10 176	10 570	57 227
Nickel-copper-zinc	25 483	1 347	77 212	72 631	4 318	98 782
Miscellaneous metals	1 025	109	14 117	16 121	–	11 640
Subtotal metals	52 145	5 776	207 748	140 366	17 574	210 462
NONMETALS						
Asbestos	x	x	x	x	x	x
Gypsum	977	148	7 885	2 760	2 832	147
Potash	39 514	4 854	–	–	–	21 323
Rock salt	13 277	513	–	–	–	1 097
Diamonds	–	–	402	6 370	–	–
Miscellaneous nonmetals	x	x	x	x	x	x
Subtotal nonmetals	55 645	5 558	16 495	29 348	2 939	27 220
MINERAL FUELS						
Coal	3 910	. .	91 453	. .	. .	. .
Total metals, nonmetals and mineral fuels	111 700	11 334	315 696	169 714	20 513	237 682

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 37. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1994-98

	1994	1995	1996	1997	1998
			(000 tonnes)		
METALS					
Gold	21 288	25 120	30 901	33 924	29 736
Silver-lead-zinc	7 444	10 295	11 656	9 608	8 484
Uranium	1 756	1 364	1 333	979	377
Iron	95 723	95 538	95 783	94 430	96 743
Nickel-copper-zinc	92 651	113 259	98 671	94 892	109 413
Miscellaneous metals	14 887	14 899	14 659	14 166	15 142
Subtotal metals	233 748	260 475	253 003	247 999	259 893
NONMETALS					
Asbestos	x	x	x	x	x
Gypsum	8 944	8 623	8 584	9 141	8 863
Potash	38 846	40 196	34 103	38 932	39 514
Rock salt	11 758	9 854	11 226	12 690	13 277
Diamonds	0	0	0	0	402
Miscellaneous nonmetals	x	x	x	x	x
Subtotal nonmetals	73 864	72 596	67 491	76 653	72 140
STRUCTURAL MATERIALS					
Stone, all kinds quarried	110 411	120 660	112 420	120 953	129 057
Sand and gravel	247 148	230 098	217 361	227 315	231 639
MINERAL FUELS					
Coal	96 616	97 707	100 359	101 735	95 363
Total ore mined and rock quarried	761 787	781 536	750 634	774 655	788 093

Sources: Natural Resources Canada; Statistics Canada.
x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 38. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1961-98

Year	Metals	Industrial Minerals[1]	Coal	Total
		(million tonnes)		
1961	90.1	96.7	. .	186.8
1962	103.6	103.8	. .	207.4
1963	112.7	120.4	. .	233.1
1964	128.0	134.1	. .	262.1
1965	151.0	146.5	. .	297.5
1966	147.6	171.8	. .	319.4
1967	169.1	177.5	. .	346.6
1968	186.9	172.7	. .	359.6
1969	172.0	178.8	. .	350.8
1970	213.0	179.1	. .	392.1
1971	211.5	185.8	. .	397.3
1972	206.0	189.7	. .	395.7
1973	274.9	162.6	. .	437.4
1974	278.7	178.8	. .	457.5
1975	264.2	158.7	. .	422.9
1976	296.5	167.1	. .	463.6
1977	299.5	205.2	33.8	538.5
1978	248.1	205.5	36.3	489.9
1979	274.8	200.1	39.8	514.6
1980	290.1	193.5	43.9	527.5
1981	301.5	172.5	48.2	522.2
1982	238.4	121.2	53.0	412.5
1983	219.0	137.0	54.8	410.8
1984	246.4	167.8	71.2	485.4
1985	245.0	171.9	76.7	493.6
1986	256.3	179.1	72.7	508.2
1987	266.2	197.5	77.5	541.1
1988	282.1	210.3	89.3	581.6
1989	283.8	209.4	87.7	580.9
1990	280.6	195.4	89.5	565.4
1991	271.4	166.4	90.3	528.0
1992	248.2	169.2	81.4	498.8
1993	236.5	167.9	87.6	458.4
1994	233.7	184.3	96.6	514.6
1995	260.5	193.3	97.7	551.4
1996	253.0	179.9	100.4	533.3
1997	248.0	197.6	101.7	547.3
1998	259.9	201.2	95.4	556.5

Sources: Natural Resources Canada; Statistics Canada.
. . Not available.
[1] Includes nonmetallic mineral mining and all stone quarried, including stone used to make cement and lime. From 1979 onwards, coverage includes miscellaneous nonmetal mines previously excluded.
Note: Numbers may not add to totals due to rounding.

TABLE 39. CANADA, CRUDE MINERALS TRANSPORTED BY CANADIAN RAILWAYS, 1997-2000

	1997ʳ	1998ʳ	1999	2000
	(000 tonnes)			
METALLIC MINERALS				
Iron ores and concentrates	39 254	38 765	32 263	38 964
Nickel and nickel-copper ores and concentrates	3 230	3 182	2 921	2 351
Zinc ores and concentrates	1 571	1 317	499	1 158
Copper ores and concentrates	957	1 189	1 179	1 484
Lead ores and concentrates	(1)	(1)	626	1 030
Metallic ores and concentrates, n.e.s.	1 101	698	96	99
Subtotal	46 113	45 152	37 584	45 088
NONMETALLIC MINERALS				
Potash (KCl)	14 204	13 890	13 378	14 197
Sulphur	7 330	6 897	7 570	7 446
Salt	1 889	1 852	1 319	1 218
Phosphate rock	1 056	1 097	94	468
Sand, gravel and stone	1 697	1 972	2 181	3 026
Other nonmetallic minerals	5 385	5 035	5 870	5 575
Subtotal	31 561	30 742	30 412	31 930
MINERAL FUELS				
Coal	40 479	37 805	42 039	39 253
Subtotal	40 479	37 805	42 039	39 253
Total crude minerals	118 153	113 699	110 034	116 270
Total revenue freight moved by Canadian railways	288 902	279 511	236 674	252 116
Crude minerals as a percentage of total revenue freight	40.9	40.7	46.5	46.1

Source: Statistics Canada, catalogue no. 52-001-XIE.
n.e.s. Not elsewhere specified; ʳ Revised.
(1) Data are included with metallic ores and concentrates n.e.s.
Note: In previous years this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1997 and 1998 have been recalculated using the monthly data series.

TABLE 40. CANADA, PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1997-2000

	1997	1998	1999	2000
	(000 tonnes)			
METALLIC MINERAL PRODUCTS				
Alumina	4 422	4 553	5 174	5 107
Iron and steel, primary or semi-finished	4 062	4 418	2 763	3 650
Copper, primary or semi-finished	473	417	1 137	611
Aluminum, primary or semi-finished	1 363	1 451	1 528	1 460
Other nonferrous metal, primary or semi-finished	1 075	1 020	413	454
Articles of metal-based products	–	–	1 121	944
Metallic waste and scrap	1 567	1 563	2 049	2 022
Total metallic mineral products	12 962	13 422	14 186	14 249
NONMETALLIC MINERAL PRODUCTS				
Sulphuric acid	2 357	2 561	2 245	2 384
Fertilizers (excluding potash)	5 256	5 038	4 963	5 041
Cement	2 115	2 084	2 261	2 443
Other nonmetallic mineral products	1 979	2 023	1 040	828
Total nonmetallic mineral products	11 706	11 886	10 509	10 696
MINERAL FUEL PRODUCTS				
Gasoline and aviation turbine fuel	1 547	1 604	1 494	1 539
Fuel oils and crude petroleum	1 099	1 505	3 297	3 357
Gaseous hydrocarbons, including liquefied petroleum gases	1 489	3 814	4 258	4 451
Coal coke and petroleum coke	1 626	1 361	1 253	1 344
Other refined petroleum and coal products	1 069	3 606	1 881	1 994
Total mineral fuel products	6 829	11 890	12 184	12 684
Total processed mineral products	31 498	37 198	36 878	37 629
Total revenue freight[1] moved by Canadian railways	288 902	279 511	236 674	252 116
Crude minerals as a percentage of total revenue freight	10.9	13.3	15.6	14.9

Source: Statistics Canada, catalogue no. 52-001-XIE

– Nil.

[1] Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years, this table was calculated using Statistics Canada's annual data series.

As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1997 and 1998 have been recalculated using the monthly data series.

TABLE 41. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1961-2000

Year	Total Revenue Freight[1]	Total Crude Minerals	Total Processed Mineral Products	Total Crude and Processed Minerals	Crude and Processed Minerals as a Percentage of Revenue Freight
	(million tonnes)				(%)
1961	138.9	54.1	13.6	67.7	48.7
1962	146.0	60.3	13.8	74.1	50.8
1963	154.6	62.9	15.5	78.4	50.7
1964	180.0	74.6	15.9	90.5	50.3
1965	186.2	80.9	17.3	98.2	52.7
1966	194.5	80.6	17.8	94.4	50.6
1967	190.0	81.2	17.7	98.9	52.1
1968	195.4	86.7	18.8	105.5	54.0
1969	189.0	81.9	27.6	109.5	57.9
1970	211.6	97.5	28.4	125.9	59.5
1971	214.5	95.6	27.4	123.0	57.3
1972	215.8	89.4	27.6	117.0	54.2
1973	241.2	113.1	29.1	142.2	59.0
1974	246.3	115.3	30.9	146.2	59.4
1975	226.0	110.6	26.6	137.2	60.7
1976	238.5	116.6	25.5	142.1	59.6
1977	247.2	121.1	25.7	146.8	59.4
1978	238.8	107.7	26.2	133.9	56.1
1979	257.9	127.2	26.6	153.8	59.6
1980	254.4	124.8	24.6	149.4	58.7
1981	246.6	120.7	26.4	147.1	59.7
1982	212.5	95.7	21.0	116.7	54.9
1983	222.8	95.3	22.7	118.0	53.0
1984	254.6	121.1	25.1	146.2	57.4
1985	250.6	125.2	24.3	149.5	59.7
1986	249.8	121.2	23.0	144.2	57.7
1987	261.4	122.2	22.7	144.9	55.4
1988	269.4	134.9	23.2	158.1	58.7
1989	247.0	122.3	23.1	145.4	58.9
1990	226.3	112.1	20.1	132.2	58.4
1991	233.3	114.4	19.1	133.5	57.2
1992	226.2	102.8	20.9	123.7	54.7
1993	224.0	100.8	21.4	122.2	54.6
1994	253.6	112.6	21.4	134.0	52.9
1995	253.7	118.4	22.0	140.4	55.4
1996	252.1	118.1	21.6	139.7	55.4
1997r	288.9	118.2	31.5	149.7	51.8
1998r	279.5	113.7	37.2	150.9	54.0
1999	236.7	110.0	36.9	146.9	62.1
2000	252.1	116.3	37.6	153.9	61.0

Source: Statistics Canada, catalogue no. 52-001-XIE.

[1] Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years, this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1997 and 1998 have been recalculated using the monthly data series.

TABLE 42. CANADA, CRUDE MINERALS LOADED AND UNLOADED IN COASTWISE SHIPPING, 1999

	Loaded					Unloaded				
	Atlantic	St. Lawrence	Great Lakes	Pacific	Total	Atlantic	St. Lawrence	Great Lakes	Pacific	Total
					(tonnes)					
METALLIC MINERALS										
Iron ore and concentrates	–	7 056 982	6 211	24 434	7 087 627	–	1 336 285	5 726 908	24 434	7 087 627
Aluminum ores and concentrates	–	26 291	–	–	26 291	–	–	26 291	–	26 291
Other ores and concentrates	600	3 133 903	224 324	–	3 358 827	–	3 045 395	313 432	–	3 358 827
Total metallic minerals	600	10 217 176	230 535	24 434	10 472 745	–	4 381 680	6 066 631	24 434	10 472 745
NONMETALLIC MINERALS										
Salt	1 454 971	15 042	1 565 032	49 536	3 084 581	450 768	1 498 007	1 086 270	49 536	3 084 581
Limestone	226 719	–	1 874 518	893 337	2 994 574	31 373	195 346	1 874 518	893 337	2 994 574
Sand and gravel	100 954	–	227 992	1 145 817	1 474 763	104 558	24 706	203 285	1 142 213	1 474 762
Gypsum	976 641	16 692	–	67 390	1 060 723	226 254	473 897	293 183	67 390	1 060 724
Potash	–	–	88 696	–	88 696	5 436	33 325	49 935	–	88 696
Sulphur	–	–	–	1 420	1 420	–	–	–	1 420	1 420
Other mineral products (including clays, coal briquettes, greases and asphalt)	417 053	107 196	2 436 712	633 769	3 594 730	200 520	605 231	2 115 209	633 769	3 594 729
Total nonmetallic minerals	3 176 338	138 930	6 192 950	2 791 269	12 299 487	1 018 909	2 830 512	5 662 400	2 787 665	12 299 486
MINERAL FUELS										
Coal and coke	–	–	699 181	69 473	768 654	1 614	127 596	569 971	69 473	768 654
Crude petroleum	1 481 438	5 914	–	47 730	1 535 082	1 529 168	5 914	–	–	1 535 082
Total mineral fuels	1 481 438	5 914	699 181	117 203	2 303 736	1 530 782	133 510	569 971	69 473	2 303 736
Total crude minerals	4 658 376	10 362 020	7 122 666	2 932 906	25 075 968	2 549 691	7 345 702	12 299 002	2 881 572	25 075 967
Total all commodities[1]	7 922 233	13 972 106	14 120 389	14 776 525	50 791 253	6 604 986	14 033 579	15 427 497	14 725 191	50 791 253
Crude minerals as a percentage of all products	58.8	74.2	50.4	19.8	49.4	38.6	52.3	79.7	19.6	49.4

Source: Statistics Canada.

– Nil.

[1] Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded in coastwise shipping.

Note: Numbers may not add to totals due to rounding.

TABLE 43. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED IN COASTWISE SHIPPING, 1999

	Loaded					Unloaded				
	Atlantic	St. Lawrence	Great Lakes	Pacific	Total	Atlantic	St. Lawrence	Great Lakes	Pacific	Total
	(tonnes)									
METALLIC MINERAL PRODUCTS										
Iron, steel and alloys	184	8 922	642	32 216	41 964	487	539	8 721	32 216	41 963
Aluminum and aluminum products	–	220 372	–	–	220 372	–	220 372	–	–	220 372
Other base-metal products	690	16 290	–	–	16 980	4 386	12 594	–	–	16 980
Total metallic mineral products	874	245 584	642	32 216	279 316	4 873	233 505	8 721	32 216	279 315
NONMETALLIC MINERAL PRODUCTS										
Cement and related products	712	37 013	425 028	32 854	495 607	712	3 885	458 156	32 854	495 607
Other processed nonmetallic minerals, n.e.s.	235 958	17 969	5 314	209 878	469 119	101 174	152 753	5 314	209 878	469 119
Total nonmetallic mineral products	236 670	54 982	430 342	242 732	964 726	101 886	156 638	463 470	242 732	964 726
MINERAL FUEL PRODUCTS										
Gasoline	1 042 477	563 838	186 947	121 717	1 914 979	1 196 235	292 449	304 578	121 717	1 914 979
Other processed mineral fuels, n.e.s.	1 552 279	1 807 670	926 485	110 329	4 396 763	1 711 761	1 440 289	1 134 384	110 329	4 396 763
Total mineral fuel products	2 594 756	2 371 508	1 113 432	232 046	6 311 742	2 907 996	1 732 738	1 438 962	232 046	6 311 742
Total processed mineral products	2 832 300	2 672 074	1 544 416	506 994	7 555 784	3 014 755	2 122 881	1 911 153	506 994	7 555 783
Total all commodities[1]	7 922 233	13 972 106	14 120 389	14 776 525	50 791 253	6 604 986	14 033 579	15 427 497	14 725 191	50 791 253
Processed mineral products as a percentage of all commodities	35.8	19.1	10.9	3.4	14.9	45.6	15.1	12.4	3.4	14.9

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified.
[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.
Note: Numbers may not add to totals due to rounding.

TABLE 44. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN COASTWISE SHIPPING, 1961-99

Year	Total All Commodities[1]	Total Crude Minerals	Total Processed Minerals	Crude and Processed Minerals as a Percentage of All Products
		(000 tonnes)		(%)
1961	41 861	9 527	8 857	43.9
1962	39 763	8 361	9 768	45.6
1963	40 328	7 998	9 942	44.5
1964	47 171	8 522	11 194	41.8
1965	48 200	9 183	11 766	43.5
1966	55 122	10 155	12 653	41.4
1967	49 799	11 509	12 207	47.6
1968	50 921	13 698	13 245	52.9
1969	51 890	12 746	14 181	51.9
1970	57 301	14 415	14 818	51.0
1971	55 128	14 783	15 374	54.7
1972	55 326	14 197	15 290	53.3
1973	55 314	16 573	15 615	58.2
1974	53 633	11 723	16 575	52.8
1975	54 373	15 687	17 510	61.1
1976	53 882	15 924	16 208	59.6
1977	58 309	18 131	17 435	61.0
1978	60 668	18 318	16 619	57.6
1979	79 950	22 130	17 486	49.6
1980	82 761	22 947	17 134	48.4
1981	71 271	17 849	16 669	48.4
1982	65 881	16 473	13 214	45.1
1983	67 598	21 248	12 025	49.2
1984	68 698	22 798	11 909	50.5
1985	61 717	19 867	10 291	48.9
1986	60 506	19 901	10 264	49.9
1987	67 572	20 969	11 118	47.5
1988	69 974	23 325	11 676	50.0
1989	62 016	22 963	11 825	56.1
1990	60 360	22 430	16 096	63.8
1991	58 430	19 624	10 370	51.3
1992	52 262	22 125	9 325	60.2
1993	49 976	21 088	8 168	58.5
1994	51 534	21 221	9 510	59.6
1995	50 370	20 626	8 825	58.5
1996	48 829	22 393	7 634	61.5
1997	46 639	20 298	7 461	59.5
1998	47 928	23 358	8 142	65.7
1999	50 791	25 076	7 556	64.2

Source: Statistics Canada.

[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.

TABLE 45. CANADA, CRUDE MINERALS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,[1] 1997-99

	1997		1998		1999	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERALS						
Iron ore and concentrates	32 875 255	8 033 932	30 793 211	7 631 659	28 031 061	7 526 759
Aluminum ores and concentrates	81 200	2 771 756	84 099	2 912 687	15 586	2 841 851
Lead and zinc ores and concentrates	924 026	452 714	990 191	560 450	449 623	581 774
Copper and nickel ores and concentrates	751 545	218 313	712 123	383 969	474 800	458 345
Other ores and base-metal products	1 329 312	332 979	2 065 168	250 453	1 891 167	340 828
Total metallic minerals	35 961 338	11 809 694	34 644 792	11 739 218	30 862 237	11 749 557
NONMETALLIC MINERALS						
Limestone	2 654 250	3 096 455	2 843 399	2 979 514	2 807 913	2 932 627
Sand and gravel	1 537 271	793 206	857 713	782 724	1 818 787	369 750
Gypsum	6 157 811	457 371	6 301 586	509 495	6 905 149	534 850
Salt	3 493 441	1 094 266	4 187 659	989 121	3 717 679	1 096 312
Sulphur	5 512 305	534	5 231 603	86	5 379 066	309
Potash	6 117 530	28	4 764 411	18	4 834 806	6 656
Other mineral products (including clays, coal briquettes, greases and asphalt)	4 925 802	2 805 177	5 895 738	3 112 470	6 081 157	2 738 258
Total nonmetallic minerals	30 398 410	8 247 037	30 082 109	8 373 428	30 907 557	7 678 762
MINERAL FUELS						
Coal and coke	36 549 641	15 081 228	33 682 218	19 443 252	32 312 668	20 561 540
Crude petroleum	8 073 655	30 364 239	9 310 254	27 903 439	9 281 348	28 450 563
Other mineral fuels	–	–	–	–	–	–
Total mineral fuels	44 623 296	45 445 467	42 992 472	47 346 691	41 594 016	49 012 103
Total crude mineral products	110 983 044	65 502 198	107 719 373	67 459 337	103 363 810	68 440 422
Total all commodities[1]	187 716 502	94 535 096	178 893 100	100 457 100	179 172 916	101 485 641
Crude minerals as a percentage of all commodities	59.1	69.3	60.2	67.2	57.7	67.4

Source: Statistics Canada.
– Nil.
[1] Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded at Canadian ports.
Note: Numbers may not add to totals due to rounding.

TABLE 46. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,[1] 1997-99

	1997		1998		1999	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERAL PRODUCTS						
Iron, steel and alloys	1 451 001	3 638 383	1 249 954	5 065 878	145 844	1 079 083
Nonferrous metals, n.e.s.	1 047 466	3 914 078	1 030 974	4 253 307	885 477	4 112 018
Total metallic mineral products	2 498 467	7 552 461	2 280 928	9 319 185	1 031 321	5 191 101
NONMETALLIC MINERAL PRODUCTS						
Cement and related products	2 739 896	375 340	3 453 497	675 398	3 525 229	713 202
Other nonmetallic minerals, n.e.s.	2 142 140	1 747 880	2 272 853	1 801 768	2 737 138	2 193 651
Total nonmetallic mineral products	4 882 036	2 123 220	5 726 350	2 477 166	6 262 367	2 906 853
MINERAL FUEL PRODUCTS						
Gasoline	4 114 237	1 958 796	3 963 390	1 788 736	4 326 864	1 851 140
Fuel oil	3 955 310	2 635 535	3 808 619	3 340 323	3 775 318	2 282 998
Coke, petroleum and coal products	573 595	1 009 136	518 117	1 071 176	441 624	1 346 534
Other mineral fuels, n.e.s.	2 443 171	1 363 522	121 098	676 223	2 895 947	1 613 047
Total mineral fuel products	11 086 313	6 966 989	8 411 224	6 876 458	11 439 753	7 093 719
Total processed mineral products	18 466 816	16 642 670	16 418 502	18 672 809	18 733 441	15 191 673
Total all commodities[1]	187 716 502	94 535 096	178 893 100	100 457 100	179 172 916	101 485 641
Processed mineral products as a percentage of all commodities	9.8	17.6	9.2	18.6	10.5	15.0

Source: Statistics Canada.
n.e.s. Not elsewhere specified.

[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.

Note: Numbers may not add to totals due to rounding.

TABLE 47. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE, 1961-99

Year	Total All Commodities[1]	Total Crude Minerals	Total Processed Minerals	Crude and Processed Minerals as a Percentage of All Products
		(000 tonnes)		(%)
1961	48 771	23 241	2 133	52.0
1962	54 676	30 446	2 296	59.9
1963	62 031	32 214	2 503	56.0
1964	75 760	42 087	2 602	59.0
1965	74 521	41 338	2 746	59.2
1966	76 192	41 374	3 350	58.7
1967	72 598	42 704	3 701	63.9
1968	78 663	48 680	2 960	65.6
1969	70 432	42 442	3 456	65.2
1970	95 807	55 849	4 965	63.5
1971	95 887	53 245	5 022	60.8
1972	98 988	51 912	9 091	61.6
1973	112 434	64 195	10 103	66.1
1974	106 110	64 093	9 041	68.9
1975	102 444	61 970	7 495	67.8
1976	114 815	71 527	6 108	67.6
1977	119 770	70 257	5 979	63.7
1978	116 522	62 291	7 556	59.9
1979	134 639	79 685	8 901	65.8
1980	138 161	67 898	11 770	57.7
1981	145 445	83 007	9 022	63.3
1982	125 282	65 594	7 115	58.0
1983	129 490	67 152	6 197	56.6
1984	145 322	82 752	7 986	62.4
1985	143 421	83 878	10 814	66.0
1986	144 561	84 720	8 303	64.3
1987	158 994	86 085	10 488	60.7
1988	171 064	98 934	12 227	65.0
1989	159 069	90 807	13 624	65.7
1990	159 039	88 504	15 107	65.1
1991	168 030	90 165	16 138	63.3
1992	153 786	78 600	14 643	60.6
1993	152 162	81 418	16 723	64.5
1994	169 463	94 423	15 725	65.0
1995	176 540	100 103	16 346	66.0
1996	174 306	96 952	18 580	66.3
1997	187 717	110 983	18 467	69.0
1998	178 893	107 719	16 419	69.4
1999	179 173	103 364	18 733	68.1

Source: Statistics Canada.

[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.

TABLE 48. CANADA, CAPITAL AND REPAIR EXPENDITURES BY SELECTED INDUSTRIAL SECTOR, 1999-2001

		Capital Expenditures			Repair Expenditures[1]		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
		($ millions)					
Agriculture, forestry, fishing and hunting	1999	1 567.9	2 624.5	4 192.4	739.6	2 534.0	3 273.6
	2000[p]	1 568.1	2 650.4	4 218.5	. .	. .	. .
	2001[i]	1 612.8	2 631.9	4 244.7	. .	. .	. .
Mining[2]	1999	15 407.4	2 930.3	18 337.7	685.5	1 959.6	2 645.1
	2000[p]	19 077.1	4 666.6	23 743.7	. .	. .	. .
	2001[i]	20 756.7	4 526.9	25 283.6	. .	. .	. .
Manufacturing	1999	3 656.1	16 574.7	20 230.8	1 563.3	8 920.7	10 484.0
	2000[p]	3 885.9	17 377.2	21 263.1	. .	. .	. .
	2001[i]	3 579.3	16 177.6	19 756.9	. .	. .	. .
Construction	1999	326.2	2 424.5	2 750.7	64.4	1 060.6	1 125.0
	2000[p]	342.8	2 569.7	2 912.5	. .	. .	. .
	2001[i]	347.5	2 641.1	2 988.6	. .	. .	. .
Transportation and warehousing	1999	6 367.2	6 754.0	13 121.2	1 447.3	3 791.5	5 238.8
	2000[p]	5 729.8	5 139.2	10 869.0	. .	. .	. .
	2001[i]	5 088.8	5 218.2	10 307.0	. .	. .	. .
Utilities	1999	4 340.3	3 216.2	7 556.5	941.3	1 279.1	2 220.4
	2000[p]	5 182.4	3 058.8	8 241.2	. .	. .	. .
	2001[i]	5 943.8	3 022.6	8 966.4	. .	. .	. .
Wholesale and retail trade	1999	1 660.7	2 064.6	3 725.3	243.1	349.5	592.6
	2000[p]	1 919.4	2 357.4	4 276.8	. .	. .	. .
	2001[i]	1 765.1	2 058.1	3 823.2	. .	. .	. .
Housing	1999	41 121.1	–	41 121.1	5 445.3	–	5 445.3
	2000[p]	42 698.0	–	42 698.0	. .	. .	. .
	2001[i]	45 018.0	–	45 018.0	. .	. .	. .
Total[3]	1999	100 877.5	70 425.4	171 302.9	16 719.6	24 386.6	41 106.2
	2000[p]	107 786.9	72 117.3	179 904.2	. .	. .	. .
	2001[i]	112 715.1	70 336.8	183 051.9	. .	. .	. .
Mining as a percentage of total	1999	15.3	4.2	10.7	4.1	8.0	6.4
	2000[p]	17.7	6.5	13.2	. .	. .	. .
	2001[i]	18.4	6.4	13.8	. .	. .	. .

Source: Statistics Canada.

– Nil; . . Not available; [i] Intentions; [p] Preliminary actual.

[1] Repair data are not available for 1999 and 2000. [2] Includes mines, quarries and oil wells. [3] Includes finance, real estate, insurance, commercial services, institutions and government departments.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the 1980 Standard Industrial Classification.

TABLE 49. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINERAL INDUSTRY[1] BY PROVINCE AND TERRITORY, 1999-2001

Province/ Territory		Capital Expenditures			Repair Expenditures[2]		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
		($ millions)					
Newfoundland	1999	1 539.8	46.1	1 585.9	x	x	x
	2000[p]	x	x	1 210.7	. .	. .	. .
	2001[i]	x	x	812.6	. .	. .	. .
Nova Scotia	1999	1 242.9	52.9	1 295.8	0.7	32.3	33.0
	2000[p]	559.6	45.8	605.4	. .	. .	. .
	2001[i]	606.2	21.0	627.2	. .	. .	. .
New Brunswick	1999	x	x	69.9	x	x	75.8
	2000[p]	x	x	106.3	. .	. .	. .
	2001[i]	x	x	55.5	. .	. .	. .
Quebec	1999	651.9	419.0	1 070.9	49.0	311.6	360.6
	2000[p]	890.0	332.3	1 222.3	. .	. .	. .
	2001[i]	622.8	618.6	1 241.4	. .	. .	. .
Ontario	1999	479.5	219.9	699.4	54.5	243.3	297.3
	2000[p]	453.5	257.9	711.4	. .	. .	. .
	2001[i]	485.0	221.1	706.1	. .	. .	. .
Manitoba	1999	115.0	12.1	127.1	3.2	54.6	57.8
	2000[p]	206.3	34.6	240.9	. .	. .	. .
	2001[i]	206.2	38.0	244.2	. .	. .	. .
Saskatchewan	1999	1 185.7	173.7	1 359.4	98.2	148.2	246.4
	2000[p]	1 512.8	169.3	1 682.1	. .	. .	. .
	2001[i]	1 530.2	170.7	1 700.9	. .	. .	. .
Alberta	1999	8 718.6	1 867.8	10 586.4	376.4	640.9	1 107.3
	2000[p]	12 553.9	3 200.7	15 754.6	. .	. .	. .
	2001[i]	14 398.3	3 151.7	17 550.0	. .	. .	. .
British Columbia	1999	1 010.9	105.4	1 116.3	70.9	257.2	328.1
	2000[p]	1 690.8	115.5	1 806.3	. .	. .	. .
	2001[i]	1 642.8	119.0	1 761.8	. .	. .	. .
Yukon	1999	22.2	1.8	24.0	x	x	x
	2000[p]	16.8	0.4	17.2	. .	. .	. .
	2001[i]	30.2	1.8	32.0	. .	. .	. .
Northwest Territories	1999	251.1	10.6	261.7	7.2	62.0	69.2
	2000[p]	305.1	38.7	343.8	. .	. .	. .
	2001[i]	465.4	38.9	504.3	. .	. .	. .
Nunavut	1999	x	x	x	x	x	x
	2000[p]	x	x	x	. .	. .	. .
	2001[i]	x	x	x	. .	. .	. .
Total Canada	1999	15 407.4	2 930.3	18 337.7	685.5	1 959.6	2 645.1
	2000	19 077.1	4 666.6	23 743.7	. .	. .	. .
	2001	20 756.7	4 526.9	25 283.6	. .	. .	. .

Source: Statistics Canada.

. . Not available; x Confidential; [i] Intentions; [p] Preliminary actual.

[1] Includes mines, quarries and oil wells. [2] Repair data are not available for 1999 and 2000.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the 1980 Standard Industrial Classification.

TABLE 50. CANADA, CAPITAL AND REPAIR[1] EXPENDITURES IN THE MINING AND OIL AND GAS EXTRACTION INDUSTRIES, 1999-2001

	1999			2000[p]	2001[i]
	Capital	Repair	Total	Capital	Capital
			($ millions)		
MINERAL EXTRACTION					
Metal ore mining					
Iron	168.80	233.40	402.20	372.00	690.10
Gold and silver	477.80	216.00	693.80	596.50	596.10
Lead-zinc	60.40	x	x	x	57.80
Nickel-copper	234.20	167.90	402.10	312.00	291.10
Copper-zinc	198.00	120.60	318.60	250.30	216.50
Uranium	219.50	x	x	x	57.30
Other metal mines	480.00	42.00	522.10	200.70	113.30
Total	1 837.70	908.70	2 747.40	1 935.10	1 825.00
Nonmetallic mineral mining and quarrying					
Stone	164.20	35.90	200.10	103.90	73.40
Sand and gravel, clay, and ceramic and refractory	37.00	44.40	81.50	69.70	74.20
Asbestos	x	x	x	x	x
Gypsum	x	x	x	x	x
Potash	76.00	100.70	176.70	137.00	123.60
Peat	23.60	14.30	37.80	22.10	15.10
Other nonmetal mines	61.60	114.40	176.00	113.90	109.90
Total	85.20	128.70	213.80	136.00	125.00
Coal	178.50	230.60	409.10	128.00	118.90
Oil and gas extraction	14 893.60	858.90	15 752.40	20 066.40	21 726.10
Service industries incidental to mineral extraction	986.00	287.60	1 273.60	1 052.10	1 125.30
Total mineral industry	18 337.70	2 645.10	20 982.80	23 743.80	25 283.60

Source: Statistics Canada.

[i] Intentions; [p] Preliminary actual; x Confidential.

[1] Repair data are not available for 1999 and 2000.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the 1980 Standard Industrial Classification.

Definitions and Valuation: Mineral Production, Shipments and Trade

MINERAL STATISTICS

The publication of statistics on the mineral production of Canada was instituted by the Geological and Natural History Survey of Canada as early as 1886. The Department of Mines carried out this compilation through the early part of the twentieth century. Subsequently, the work was transferred to Statistics Canada, which published the data for the period 1921 to 1978. In January 1979, the responsibility for Canadian non-fuel mineral statistics was transferred from Statistics Canada to the Department of Energy, Mines and Resources (now Natural Resources Canada). Statistics Canada retains responsibility for fuels and mineral manufacturing statistics (including cement, lime, clay, and smelting and refining).

The construction of new metallurgical plants and the development of new types of ore have resulted in changes in methods of compilation over the period but, in general, the following principles have been followed.

For nonmetallic minerals such as asbestos, talc, barite, etc., and for structural materials such as stone, cement, etc., the mine or quarry shipments are taken to represent production. Usually there is little difference between actual output and mine shipments, and it is more convenient and practical to measure the product at the latter point. Values are computed on the f.o.b. shipping point basis and they represent, therefore, the amounts actually received by the producers. Values are adjusted to exclude the costs of containers, taxes, duties, sales discounts and outward-bound transportation.

Production data for certain simple metallic ores such as iron ore, uranium, etc., are compiled in a similar manner, that is, products shipped from a specific shipping point at f.o.b. values. For some metals this is not practical and an attempt is made to measure output in terms of recoverable metals in concentrates shipped, which are then valued at current market prices.

The value of metallic mineral production calculated in this manner does not coincide with the amounts actually received by the producers.

DETAILS OF THE METHODS USED IN COMPUTING THE MINERAL PRODUCTION OF CANADA

Metallic Mineral Production

Antimony

Production includes recoverable antimony in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Bismuth

Production includes recoverable bismuth in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Cadmium

Cadmium is associated with zinc. Production includes the recoverable content of cadmium in the zinc-lead concentrates shipped, valued at the yearly average New York dealer price.

Calcium

Output figures represent calcium metal plus the calcium content of alloys from Canadian sources valued at the average yearly price of metal crowns.

Cesium

Production figures represent the cesium oxide content of pollucite ore shipped. The value is as reported by the producer.

Cobalt

Production includes recoverable cobalt in concentrates shipped. The value is calculated using the average yearly cathode dealer spot prices.

Copper

Production includes recoverable copper in concentrates shipped. The value is calculated using a combination of the Commodities Exchange, Inc. (COMEX) first position price and the average London Metal Exchange Grade A Settlement price.

Germanium

Production includes germanium contained in concentrates shipped with values as reported by the shipper.

Gold

Production includes gold in crude bullion obtained directly from placer workings and lode gold mines, and recoverable gold in all types of ores and concentrates shipped. The value is calculated using the average final price as established by bullion dealers in London.

Ilmenite

Production includes shipments of direct shipping grade ore at Canada's sole shipper's reported value.

Indium

Production includes quantities recovered in the smelting of silver-lead-zinc ores from Canadian sources. The output is valued by the shipper.

Iron Ore

Production figures represent product shipments (pellets, concentrates, ores) at the values shown by the shippers. Production from steel plant waste oxides is excluded.

Iron (Remelt)

This is sometimes called pig iron or Sorel iron. It is a co-product in the smelting of ilmenite ores. Quantity and value figures are those reported by the producer.

Lead

Production includes recoverable lead in concentrates shipped. The value is computed at the average producer price for the year.

Lithium

Production figures represent the lithium oxide content of spodumene and amblygonite ore shipped. The value is as reported by the producer.

Magnesium

Output figures represent magnesium metal, plus the magnesium content of alloys from Canadian sources. Values are compiled using the average yearly price of primary ingots.

Molybdenum

Production figures are the molybdenum content of the oxides, ferromolybdenum and sulphides shipped; the value is that shown by the shipper.

Nickel

Production includes recoverable nickel in concentrates shipped. The value is calculated using an assessment price based on London Metal Exchange prices.

Niobium (Columbium)

Production includes niobium (columbium) contained in concentrates shipped with values as reported by the shipper.

Platinum Group Metals (PGM)

Production figures for iridium, palladium, platinum, ruthenium and rhodium include recoverable metal in concentrates shipped. Quantities are valued using average New York dealer prices or London Metal Exchange prices, depending on the metal.

Rhenium

Production figures reflect the content of concentrates shipped. Values are those reported by the shipper.

Rubidium

Production figures include the content of concentrates shipped. Values are as reported by the shipper.

Selenium

Production includes selenium produced as a refinery by-product from Canadian sources and recoverable selenium contained in concentrates exported. The quantities are valued at the average New York dealer price for the year.

Silver

Production includes silver in crude bullion obtained directly from placer workings and lode gold mines, and recoverable silver in all types of ores and concentrates shipped. The value is calculated using the average of Toronto quotations for the year.

Tantalum

Production comprises the tantalum pentoxide content of concentrates shipped as valued by the shipper.

Tellurium

Production includes tellurium produced as a refinery by-product from Canadian sources and recoverable tellurium contained in concentrates exported. The quantities are valued at the average producers' price for the year.

Tin

Production figures comprise recoverable tin in tin concentrates shipped. The value is based on the average New York dealer price for the year.

Uranium

Producers of uranium precipitates or concentrates report the metal content (U) of the shipments and the value is calculated by Natural Resources Canada.

Zinc

Production comprises recoverable zinc in concentrates shipped. The value is calculated using the average London Metal Exchange price for the year.

Nonmetallic Mineral Production

Owing to the fact that it is difficult to obtain figures of the actual production of nonmetallic minerals in Canada, and since the first actual measurement is when the product is sold, plant shipments have been taken to represent production in all cases.

Barite

Production is the shipments of the various grades at the selling value, f.o.b. shipping points.

Cement

Production comprises shipments of Portland and masonry cements, exported clinker, and transfers to other corporate divisions for use in other manufacturing processes. Values are f.o.b. plant, as reported by the shipper.

Chrysotile (Asbestos)

Production figures represent shipments of the various grades at the total selling value, f.o.b. shipping points, less the value of containers.

Clay Products

Production represents shipments of brick and other clay products made from domestic clays, and shipments of unmanufactured clays (bentonite, diatomite) at the total selling value, f.o.b. works, as reported by the operators. Data relating to clay products manufactured from imported clays are not included.

Diamonds

Production is shipments from the mine. The value is calculated by Natural Resources Canada.

Gemstones

Production is the tonnage of crude and rough cut amethyst, jade and labradorite shipped at its selling value, f.o.b. shipping points.

Graphite

Production is the shipments of various grades from the mill at its selling value, f.o.b. the mill, less container costs.

Gypsum[1]

Production is taken as the tonnage of crude gypsum and anhydrite shipped from quarries or mines in lump, crushed or fine-ground forms. The value is that reported by the operators. (Note: Gypsum used in the manufacture of cement in Canadian cement plants is excluded.)

Lime

Production represents the tonnage of hydrated and quicklime shipped (sold by the producer) together with the tonnage of these limes produced and used by the producers of chemicals and allied products. The values are as reported by the producer.

Magnesitic Dolomite (Magnesite)

Production is the tonnage of crude material sold by primary producers, plus the tonnage of calcined or dead-burned material sold or used by primary producers. The value is that reported by the producers.

Marl

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Mica

Production is recorded as shipments from plants dressing new mica, and exported shipments directly from the mines. The value of shipments is taken as reported by operators.

Nepheline Syenite

Production of crude and ground nepheline syenite is the amount of the various grades shipped at the total selling value, f.o.b. works, less container costs.

Peat

Production comprises crude peat shipped to Canadian non-producers as fuel or for export, baled peat shipped, and the peat content of mixed products shipped. Value is the sales value, f.o.b. works, less the cost of containers.

Phosphate

Production is shipments from the plant. Values are f.o.b. plant as reported by the producer.

Potash

Production represents producers' shipments of various grades from the plant and is measured as the K_2O equivalent. The value of shipments, f.o.b. plant, is reported by the producers.

Potassium Sulphate

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Pumice

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Quartz (Silica)[1]

Production represents the tonnage of crude or pulverized quartz, quartzite, pure silica sand, or other natural silica material shipped for sale, plus the tonnage of any of these materials used by producers. The value is taken as reported by producers.

Salt

Production is taken as the tonnage of various grades of dry salt shipped by primary producers, plus the salt content of brine used by producers for industrial (chemical) purposes. The value is that reported by producers.

Sand and Gravel[1]

Production represents shipments of natural gravel, sand and crushed gravel at the values reported by operators of sand and gravel pits or dredges.

Serpentine

Production represents producers' shipments of various grades valued f.o.b. plant, as reported by the producer.

Soapstone, Talc, Pyrophyllite

Production comprises crude, ground or sawn soapstone shipments; crude, milled or refined talc shipments; and crude or ground pyrophyllite shipments. All shipments are f.o.b. the mill or plant and are valued by the shipper.

Sodium Sulphate

Production is the tonnage of crude or refined natural sodium sulphate shipped at its selling value, f.o.b. shipping points. The figures exclude the sodium sulphate produced as a by-product of paper or rayon manufacturing.

Stone[1]

Production represents quarry shipments of crude or undressed stone, crushed stone and dressed stone, if the latter is prepared by the quarry operators at values as reported by the operators. The figures include data for both private and public or municipally owned properties. Production figures do not include dressed stone prepared from imported stone or prepared from domestic stone in works not at the quarries.

Sulphur in Smelter Gas

Prior to final metal recovery, sulphide concentrates are smelted or roasted and the resultant gases may be used to produce marketable sulphur, sulphur dioxide or sulphuric acid. Production is considered as the sulphur content of sulphuric acid made, sulphur dioxide marketed and sulphur shipped. This sulphur is valued at the average price for sulphur sold in acid. Production is shown by province of origin of concentrates.

Sulphur, Elemental

In the western provinces, sour natural gas is processed to remove hydrogen sulphide, which is further reduced to yellow elemental sulphur. Sulphur recovered from the refining of Canadian crude petroleum is also included. Production is shown by province of origin of material and values are as reported by the shippers.

Titanium Dioxide

Ilmenite ore is smelted at Sorel, Quebec, to produce a slag containing titanium dioxide. Production is the titanium dioxide content of slag valued by the producer.

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[1] To avoid duplication in computing a total value for Canadian mineral production, the quantity and value of gypsum, silica, stone,and sand and gravel used in the manufacture of lime, cement and clay products are not included in the totals for gypsum, silica, stone, and sand and gravel production. These particular data are recorded separately and are published in conjunction with data for the lime, cement and clay industries.

Tremolite

Production is shipments of various grades at the selling values, f.o.b. shipping point, less the value of containers.

Wollastonite

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Zeolite

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Fuels

Coal

Production figures are equal to shipments from the mine/plant plus "own" consumption as valued by shippers, f.o.b. mine/plant.

Natural Gas

Production figures represent sales of natural gas from dry gas fields after field uses, losses and reinjection, but before inventory changes. Values are as reported by the producers.

Natural Gas By-Products

Production figures for propanes, butanes, etc., represent the quantity that is available for market. It is the quantity produced by gas processing plants after processing and reprocessing plant uses, losses and shrinkage. Values are selling value, f.o.b. shipping points.

Oil, Crude and Equivalent

Production figures represent the production of crude oil from both conventional and non-conventional sources after field use, losses and reinjection. Values are those reported by shippers, f.o.b. well head or plant.

VALUATION OF TRADE DATA

(Note: The following has been extracted from Statistics Canada catalogue no. 65-003.)

For Customs purposes, imports are recorded at values established according to the provisions of the *Customs Act* which, since January 1, 1985, reflects valuation methods based on the General Agreement on Tariffs and Trade (GATT) Valuation Code System. It generally requires that the value for duty of imported goods be equivalent to the transaction value or the price actually paid.

To determine the transaction value of imported goods, all transportation and associated costs arising in respect of the goods being appraised prior to and at the place of direct shipment to Canada are to be added to the price of the goods. Therefore, Canadian imports are valued f.o.b. (free on board), place of direct shipment to Canada. The value excludes freight and insurance costs in bringing the goods to Canada from the point of direct shipment.

To countries other than the United States, exports are, in principle, valued or recorded at the values declared on export documents, which usually reflect the transaction value, i.e., actual selling price, or in the case of a non-arm's-length transaction, the transfer price used for company accounting purposes. Canadian exports to overseas countries are valued at f.o.b. port of exit, including domestic freight charges to that point, but net of discounts and allowances. As of January 1990, Canadian exports to the United States are valued f.o.b. point of exit from Canada. Prior to 1990, they were valued f.o.b. place of lading net of freight charges, discounts and allowances.